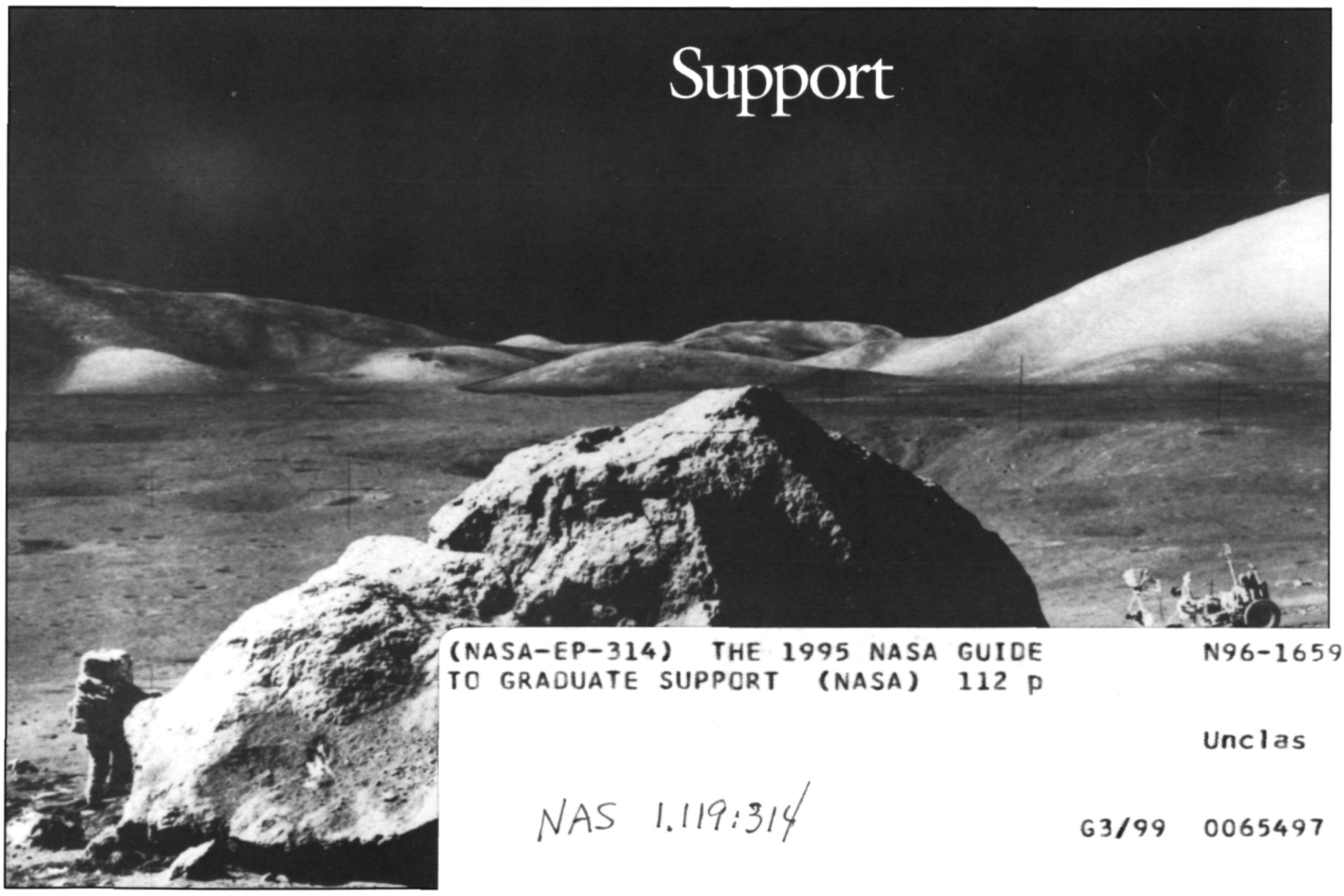
National Aeronautics and
Space Administration
Office of Human Resources
and Education
Education Division

Educational Program	
Students	University

1995

NASA Guide to Graduate Support



About the Cover:
Astronaut Harrison ("Jack") Schmitt collects samples of a huge boulder in the Moon's Littrow Valley during the *Apollo 17* Mission in December 1972. This region is one of the most rugged and scenic visited by the six landings of the *Apollo* Program. Beyond the large boulder is the flat floor of the Littrow Valley, covered by dark mare material (lava flows). Beyond the Valley are the Taurus Mountains, made up of older highly cratered highland rocks. The Lunar Rover, used by the astronauts to explore the surface, is visible to the right of the rock.

1995 NASA Guide to Graduate Support

NASA Headquarters
Office of Human Resources and Education
Education Division
Higher Education Branch
Washington, DC 20546

EP-314
September 1994

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Section I

1995 NASA Graduate Student Researchers Program

General Information

Introduction

Education Division
Higher Education Branch
Code FEH
NASA Headquarters
Washington, DC 20546

The future of the United States is in the classrooms of America and tomorrow's scientific and technological capabilities are derived from today's investments in research. In 1980, NASA initiated the Graduate Student Researchers Program (GSRP) to cultivate additional research ties to the academic community and to support promising students pursuing advanced degrees in science and engineering. Since then, approximately 1,300 students have completed the program's requirements. In 1987, the program was expanded to include the Underrepresented Minority and Disabled Focus (UMDF) Component. This program was designed to increase participation of underrepresented groups in graduate study and research and, ultimately, in space science and aerospace technology careers.

Approximately 270 minority students have completed the program's requirements while making significant contributions to the nation's aerospace efforts. Continuing to expand fellowship opportunities, NASA announced the Graduate Student Fellowships in Global Change Research in 1990. Designed to support the rapid growth in the study of Earth as a system, more than 250 fellowships have been awarded. And, in 1992, NASA announced opportunities in the multiagency High Performance Computing and Communications (HPCC) Program designed to accelerate the development and application of massively parallel processing. Approximately five new fellowships will be awarded yearly.

This booklet will guide you in your efforts to participate in programs for graduate student support.

Section II — lists areas of research activities at NASA facilities. Refer to this section for a detailed description of research opportunities when applying to any of the graduate student programs.

Section III — describes the Underrepresented Minority and Disabled Focus (UMDF) Component.

Section IV — describes the High Performance Computing and Communications (HPCC) program.

Section V — describes the Graduate Student Fellowships in Global Change Research, including objectives, and administrative and application procedures.

During the next year, NASA will select at least 200 new graduate student researchers to receive stipends and to work at our unique national laboratories. We are pleased to offer these programs and hope students and faculty will continue to benefit from them.

Program Summaries

Graduate Student Researchers Program

The NASA Graduate Student Researchers Program (GSRP) attempts to reach a culturally diverse group of promising U.S. graduate students whose research interests are compatible with NASA's programs in space science and aerospace technology. Each year approximately 100 new awardees are selected based on competitive evaluation of their academic qualifications, their proposed research plan and plan of study, and their planned utilization of NASA research facilities. Fellowships of up to $22,000 are awarded for one year and are renewable, based on satisfactory progress, for a total of three years. Approximately 300 graduate students are supported by this program each year. Students may apply at any time during their graduate career or prior to receiving their baccalaureate degree. An applicant must be sponsored by his/her graduate department chair or faculty advisor; other eligibility requirements are described in the Administrative Procedures section of this book.

Approximately fifty of the 100 new awards each year are sponsored by NASA Headquarters through the Office of Space Science (OSS), the Office of Life and Microgravity Sciences and Applications (OLMSA), and the Office of Mission to Planet Earth (MTPE) in the fields of astrophysics, solar system exploration, space physics, information systems, microgravity science and applications, life sciences, and Earth sciences. Students applying for these fellowships are competitively evaluated on their academic qualifications and proposed research and plan of study by NASA discipline scientists and an external merit review group. **Headquarters selected fellows carry out research or a plan of study at their home universities and attend a three-day annual symposium in Washington, D.C.** The symposium provides an opportunity for GSRP fellows to exchange ideas, discuss progress, and learn more about space sciences at NASA. Headquarters research opportunities are described in the Areas of Research section of this book.

The remaining new awards are distributed throughout NASA field centers. **Fellows selected by centers must spend some period of time in residence at the center, taking advantage of the unique research facilities of the installation and working with center personnel.** The projected use of center expertise and facilities is an important factor, along with academic qualifications and research plans, in the selection of center fellows.

✱ *Students applying for a center fellowship are strongly urged to contact the NASA researcher identified at the end of each research description prior to developing a proposal. Students applying to the Headquarters Office may contact the appropriate individual listed on page 9.*

Underrepresented Minority and Disabled Focus Component

While we have been very pleased with the success of the Graduate Student Researchers Program, we are concerned that too few members of underrepresented minority groups are participating. Thus, in 1987, NASA introduced the Underrepresented Minority and Disabled Focus Component. Applicants must be sponsored by the graduate department chair or faculty advisor. Students selected for the program will collaborate with faculty advisors and with NASA technical officers. **Students selected by NASA field centers must spend a period of residency at the center, taking advantage of the unique research facilities of the installation and working with center personnel. This period is expected to be at least one month annually, but need not be a single continuous time period.** NASA has a long history of supporting Historically Black Colleges and Universities and Other Minority Universities. NASA is particularly interested in furthering its relationship with these institutions through the GSRP (UMDF).

NASA Graduate Student Fellowships In Global Change Research

NASA established this graduate student training fellowship for persons pursuing a Ph.D. degree in aspects of global change research. The purpose is to ensure a continued supply of high-quality scientists to support rapid growth in the study of Earth as a system. More than 250 fellowships have been awarded since the inception of the program in 1990. Approximately fifty new fellowships will be available for the 1995 academic year.

High Performance Computing and Communications

At least five new GSRP awards will be granted in 1995 as part of the Federal High Performance Computing and Communications (HPCC) Program. HPCC is a multiagency program designed to accelerate the development and application of high performance computing systems through an integrated program of hardware, software, and network development, as well as long-term basic research. Within the Federal program, NASA will focus on: aeronautical, Earth science, and space science applications; interagency software coordination; and basic research for future HPCC systems.

Summary of NASA Research Areas

NASA Headquarters

Office of Space Science
- Astrophysics
- Information Systems
- Solar System Exploration
- Space Physics

Office of Life and Microgravity Sciences and Applications
- Life Sciences
- Microgravity Science and Applications

Office of Mission to Planet Earth
- Earth Science

Ames Research Center

Advanced Instrumentation
Advanced Life Support
Aeronautics
Aerothermal Materials and Structures
Aerothermodynamics
Aircraft Conceptual Design
Applied Computational Fluid Dynamics
Artificial Intelligence
Atmospheric Physics
Bioregenerative Life Support
Computational Fluid Dynamics
Computational Materials Science
Computer Graphics Workstations
Computer Vision
Control Algorithm for Wind Tunnel Support Systems
Earth Atmospheric Chemistry and Dynamics
Ecosystem Science
Ecosystem Science and Technology
Engineering and Technical Services
Experimental Aerodynamics
Extravehicular Systems Research and Technology Flight Research
High-Speed Computer Architectures
Human Factors
Hypersonics
Infrared Astronomy and Astrophysics
Infrared Astronomy Projects and Technology Development
Intelligence Systems Technology
Neurosciences
Physical-Chemical Closed-Loop Life Support
Planetary Biology
Planetary Science
Rotary Wing Aeromechanics
Rotorcraft Technology
Scientific Visualization and Interactive Computer Graphics
Search for Extraterrestrial Intelligence
Solar System Exploration
Space Biology
Space Physiology
Space Projects
Spacecraft Data Systems
Telecommunications
Theoretical Astrophysics
Turbulence Physics
Unsteady Viscous Flows
Wind Tunnel Automation
Wind Tunnel Composite Applications

Dryden Flight Research Facility

Advanced Digital Flight Control
Aircraft Automation
Flight Dynamics
Flight Systems
Flight Test Measurement and Instrumentation
Fluid Mechanics and Physics
Integrated Test Systems and Aircraft Development
Propulsion/Performance
Structural Dynamics

Goddard Space Flight Center

Atmospheric Chemistry and Dynamics Branch
Atmospheris Experiment Branch
Biogeochemical Cycles
Biospheric Studies
Causes of Long-Term Climate Change
Climate and Radiation Branch
Cryogenics Laboratory
Data Assimilation Office
Data Systems Technology Division
Earth Sciences Directorate
Electromechanical Branch
Engineering Directorate
Environmental Sensors
Experimental Instrumentation
Flight Dynamics Division
Global Change Data Center
Hydrological Sciences Branch
Interdisciplinary Research
Laboratory for Astronomy and Solar Physics
Laboratory for Atmospheres
Laboratory for Extraterrestrial Physics
Laboratory for High Energy
Laboratory for Hydrospheric Process
Laboratory for Terrestrial Physics
Microwave Sensors Branch
Mission Operations and Data Systems Directorate
NASA Center for Computational Science
National Space Science Data Center
Observational Science Branch
Oceans and Ice Branch
Optics Laboratory
Photonics Branch
Planetary Atmoshperes
Planetary Atmoshperes Branch
Robotics Branch
Satellite Data Utilization Office
Science Network Office
SeawiFS Project
Sensor Concepts and Calibration
Severe Storms Branch
Solid Earth Geophysics
Space Data and Computing Division
Space Geodesy
Thermal Development Laboratory
Tropical Rainfall Measuring Mission (TRMM) Office

Jet Propulsion Laboratory

Advanced Systems
Advanced Teleoperation and Man-Machine systems
Asteroid Dynamics
Astrophysics
Autonomous Control and Tracking Systems
Autonomous Mobile Vehicle
Chief Engineer
Control Systems

Data Storage Technology
Defense and Civil Information
Earth and Space Science Division
Earth Atmosphere
Earth Geoscience
Earth Observation Analysis
Electro-optical Tracking Systems
Flight Computers
Flight Projects Interface
Flight Projects Support Office
Flight Support Facilities
Frequency Standards Research
Geodynamics
Gravitational Wave Studies
Hardware Assurance Division
Image Processing Applications Development
Imaging Systems
Information Systems Division
Information Theory and Coding
Infrared and Analytical Instrument Systems
Institutional Computing and Mission Operations Division
Mechanical and Chemical Systems Division
Microelectronic Device Research
Microwave Observational Systems
Mission Design
Mission Information Systems Engineering
Mission Profile and Sequencing
Navigation Systems
Observational Systems Division
Oceanography
Optical Communication
Optical Sciences and Applications
Planetary Atmospheres
Planetary Atmospheres and Interplanetary Media
Planetary Dynamics
Planetary Radar Astronomy
Planetology
Power Research and Engineering
Process Engineering
Program Control and Administration (PC&A)
Radar Remote Sensing of the Earth
Reliability Engineering
Robot Arm Control
Software Product Assurance
Space Physics
Spacecraft System Engineering
System Integration and Test Quality Assurance
Systems Analysis
Systems Assurance Division
Systems Division

Johnson Space Center

Advanced Extravehicular (EVA) Systems
Advances Software Technology
Artificial Intelligence
Biomedical and Nutritional Research
Biotechnology and Bioprocessing
Computer Graphics Research
Endocrine Biochemistry
Environmental Physiology\Biophysics Research
Exercise Physiology
Flight Data Systems
Guidance, Navigation, and Control
Immune Responses to Space Flight
Intelligent Robotics
Life Support Systems
Orbital Debris
Pharmacokinetic Research
Physiologic Research
Planetary Materials Analysis
Propulsion and Power
Psychological Research
Regenerative Life Support Systems
Risk Management
Robotic Applications
Robotic Simulation
Space Food Development
Space Radiation
Spacecraft Thermal Management Systems
Technology Development for New Initiatives
Telerobotics and Autonomous Robotic Systems
Tracking and Communications

Kennedy Space Center

CELSS Research
Earth Sciences Advances Programs
Engineering Advanced Programs

Langley Research Center

Advanced Aircraft Systems
Advanced Computational Capability
Advanced Propulsion Technology
Advanced Sensor Systems
Aeroacoustics
Aerobraking
Aerodynamics and Aerothermodynamic Experiments
Analysis and Interpretation of Constituent and Temperature Data for the Middle Atmosphere
Climate Research Program
Computer Science
Configuration Definition for the Evolution of Space Station Freedom
Controls and Guidance
Earth Radiation Budget Experiment (ERBE)
Electromagnetics, Antennas, and Microwave Systems
Electronics and Informations Systems
Engineering Laboratory Unit
Entry Fluid Physics
Facilities Engineering
First Lunar Outpost
Fluid Physics
General Aviation
Halogen Occulation Experiment (HALOE)
High-Speed Aircraft
Human Factors
In-Space Technology Experiments
Lunar Rover Robotics Missions
Materials Characterization Technology
Measurement Science and Instrument Technology
Measurements of Air Pollution from Satellites (MAPS)
Propulsion
Space Controls and Guidance
Space Exploration Initiative
Space Systems Technology
Stratospheric Aerosol and Gas Experiment (SAGE)
Structures (Aero)
Structures (Space)
Subsystem Growth Requirements for Space Station *Freedom*
Systems Engineering

Transport Aircraft
Transportation Systems
Tropospheric Chemistry Research Program
Upper Atmosphere Research Program

Lewis Research Center

Advanced Composit Mechanics
Aerospace Applications of High Temperature Superconductivity
Aircraft Icing
Aircraft Power Transfer Technology
Aircraft Propulsion Systems Analysis
Ceramic-Matrix Composites
Computational Fluid Mechanics
Computational Structures Technology
Computational Technology
Concurrent Engineering Simulation
Controls and Dynamics
Digital Systems Technology
Electrochemical Space and Storage
Emissions Technology
Environmental Durability of Advanced Materials
Experimental Fluid Mechanics
Fan\Propeller Aerodynamics and Acoustics
High Performance Aircraft Propulsion Technology
High Performance Computing and Communications\Numerical Propulsion Simulation
High Temperature Electronics Technology
Hypersonic Propulsion Technology
In-Space Technology Experiments
Instrumentation and Sensors
Liquid Rocket Propulsion
Low Noise Nozzle Technology
Low Thrust Propulsion Fundamentals
Metal Matrix and Intermetallic Matrix Composites
Microgravity Materials Science
Microgravity Science and Applications
MMIC Technology
Molecular Computational Fluid Dynamics
Phased Array Antenna Technology
Photovoltaic Space Systems
Polymers And Polymer Matrix Composites
Power Materials Technology
Power Systems Technology
Probabilistic Structural Mechanics
Rocket Engine System Monitoring
Solar Dynamic Systems for Space Power
Space Communications Systems Analysis
Space Environmental Interactions
Space Power Management and Distribution Technology
Stirling Dynamic Power Systems
Structural Analysis and Life Prediction
Structural Dynamics
Structural Integrity
Thermal Management Technologies for Space Power Systems
Tribiology
Turbine Engine Technology
Vacuum Electronics

Marshall Space Flight Center

Aeronomy
Atmosphere\Land Surface Interface
Audio Systems
Biophysics
Climate Modeling with the CMI
Cloud Scattering of Light Discharges
Combustion Devices and Turbomachinery
Communications Systems
Component Development Division
Computational Fluid Dynamics
Configuration Management
Control Mechanisms
Controls for Vehicles
Cosmic Ray Research
Cryogenic Physics
Crystal Growth in Fluid Field and Particle Dynamic Evaluation
Docking\Berthing Sensors
Electrical Systems
Electronics, Sensors, Robotics
Engineering Graphics Workstation
Gamma Ray Astronomy
Geophysical Fluid Dynamics and Modeling
Hypervelocity Impact Design and Analysis
Infrared Astronomy
Liquid Propulsion Dynamic Analysis
Low Gravity Science
Magnetospheric and Plasma Physics
Materials and Processes Laboratory
Metallic Materials
Mission Operations Laboratory
Model Studies of Storm Electrical Processes
Nonmetallic Materials Research
Optical Systems
Physical Climate Analysis
Pointing Control Systems
Process Engineering Research
Propulsion Laboratory
Quality Engineering
Reliability Engineering
Software Data Management
Solar Physics
Space Environmental Effects on Materials
Space Vehicle Environments
Stratospheric and Mesospheric Studies
Structural Assessment: Structural Analysis
Structural Design
Structural Dynamics
Surface Properties\Atmospheric Boundaries Interactions
Systems and Components Test and Simulation
Systems Division
Systems Safety Engineering
Test Division
Thermal Analysis: Liquid Propulsion Systems
Thermal Analysis: Solid Rocket Motor
Thermal\Environmental Computational Analysis
Tropospheric Wind Profiling
Vibracoustics
X-ray Astronomy

Stennis Space Center

Active and Passive Nonintrusive Remote Sensing of Propulsion Test Parameters
Advanced Propulsion Systems Testing
Application of Parallel Computing to Data Analysis
Artificial Intelligence (AI) Capability for Intelligent Processing of Remotely Sensed and Propulsion Test Data
Computational Modeling and Simulation
Cryogenic Instrumentation and Cryogenic High Pressure, and Ultra High Pressure Fluid Systems
Earth Observation Technology
Environmental Impact from Propulsion System Testing
Ground Test Facilities Technology
Leak Detection, Sensors, Quantification and Visualization
LOX\GOX Compatible Materials
Material and Fluid Science
Nondestructive Test and Evaluation
Propellant and Pressurants Conservation, Recycling and Energy Conservation Leak Detection, Sensors, Quantification, and Visualization
Propulsion System Testing Techniques, Simulation, Modeling, and Methodologies
Propulsion Test Data Acquisition Systems
Spectroscopy Technology for Propulsion System Testing
Thermal Protection and Insulation Systems
Use of Visualization Technologies for SSC Data Analysis
Vehicle Health Maintenance\Rocket Exhaust Plume Diagnostics
Visual Data Analysis

Program Administrators

The NASA Graduate Student Researchers Program (GSRP) is managed at the national level by:

The Office of Human Resources and Education
Education Division
Higher Education Branch
Code FEH
NASA Headquarters
Washington, DC 20546

The Office of Space Science (OSS), the Office of Life and Microgravity Sciences and Applications (OLMSA), and the Office of Mission to Planet Earth (MTPE) at NASA Headquarters, along with NASA Field Centers around the United States, participate in the program. Local Program Administrators are:

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Administrative Procedures

GSRP • GSRP (UMDF)
GSRP (High Performance Computing)

Selection of Proposals — Graduate students are selected for participation in this program by NASA Headquarters, individual NASA centers, or by the Jet Propulsion Laboratory on the basis of (a) the academic qualifications of the student; (b) the quality of the proposed research and plan of study and its relevance to NASA's programs; (c) except at NASA Headquarters, the student's proposed utilization of Center research facilities; and (d) the ability of the student to accomplish the defined research.

Awards — Fellowships are made initially for a period of one year and may be renewed annually for a total of three years, based on satisfactory progress as reflected in performance evaluations by the faculty advisor. Renewals must also be approved by NASA installation Program Administrators and technical supervisors.

Eligibility — Full-time (as defined by the university) graduate students enrolled in an accredited U.S. college or university are the only persons eligible for program awards. They must be citizens of the United States. Students may enter the program at any time during their graduate work or may apply prior to receiving their baccalaureate degrees. All applications must be sponsored by the student's graduate department chair or faculty advisor. Those selected will usually receive support until they receive an advanced degree, a maximum of three years in most cases. An individual accepting this award may not concurrently receive other Federal fellowships or traineeships.

Students from underrepresented minority groups who apply to this program may also apply to the Underrepresented Minority and Disabled Focus Component (see Section III).

Equal Opportunity — No applicant shall be denied consideration or appointment as a NASA Graduate Student Researcher on the grounds of race, creed, color, national origin, age, or sex.

Obligation to the Government — A student receiving support under the Graduate Student Researchers Program does not thereby incur any formal obligation to the Government of the United States. However, the objectives of this program will clearly be served best if the student is encouraged to actively pursue research or teaching in aeronautics, space science, or space technology after completion of graduate studies.

Funding — The total annual award per graduate student cannot exceed $22,000. In addition to the $16,000 student stipend, allowances of $6,000 ($3,000 for the student allowance and $3,000 for the university allowance) may be requested to help defray tuition costs, purchase books and software, or to provide a per diem and travel allowance for the student and faculty advisor. Students participating in the Headquarters programs should plan to attend, along with their advisors, a three-day symposium in Washington, D.C., in the spring of each year. Specific details regarding this conference will be communicated after awards have been made.
The student allowance may also be used to help defray living expenses during periods of center residency. Students currently living close to the center to which they apply should request only a nominal amount for this purpose.
The university allowance may be used by the faculty advisor for supervision of the student's work and for travel to the NASA facility to oversee the student's progress. It may also be used for student tuition. Alternative uses for this allowance may be requested but must be consistent with the intent of the program.
New grant applicants attending GSRP workshops/symposiums prior to their grant start date may be reimbursed for travel expenses.

Equipment — The use of training grant funds for the purchase of nonexpendable equipment is prohibited.

Disposition of Unused Funds — If a student terminates the GSRP earlier than anticipated, the student stipend is prorated and terminated (see Replacement Student section below). Any unused student/university allowances are returned to NASA. Renewal applicants who have funds remaining from their previous year's budget may carry the remaining funds over into the following program year.

Foreign Travel — All travel outside the United States must clearly be essential to the research effort and, to be charged to a grant, have prior approval of the GSRP Manager and the NASA Grants Officer for each specific trip regardless of its inclusion in the proposed budget. A written request must state the purpose, cost and travel dates, and include the NASA fellowship number.

Replacement Student — If a student leaves the program for any reason, the university, with prior NASA Headquarters approval, may appoint another student with similar research objectives to complete only the remaining portion of the current year. If a student withdraws within the first quarter of their award year, the award will be prorated and the remaining funds deobligated. Replacement students electing to apply for the following program year are not automatically entitled to award and are subject to the evaluation and selection procedures administered to new applicants.

Documentation required for nomination of replacement students includes: proposal cover sheet signed by the student and faculty advisor, brief description of research investigation to be undertaken by the student, and the educational background of the student.

Internal Revenue Service — All questions concerning taxes should be directed to the Internal Revenue Service. Refer to IRS Publication 520 titled "Scholarships and Fellowships," and Publication 508 titled "Educational Expenses."

Final Administrative Report — It is the responsibility of the institution receiving a NASA fellowship to ensure the final report on the fellow's research and academic progress is submitted no later than 90 days after the termination date of the award. Information to be furnished includes the degree granted, important results of the student's experiences (e.g., thesis title, papers published other than thesis, presentations made, awards, honors), and employment or other future plans. This report should be submitted to:

GSRP Administrator
Higher Education Branch
Code FEH
National Aeronautics and
Space Administration
300 E Street, SW
Washington, DC 20546

A copy must also be sent to the appropriate NASA Installation Program Administrator, and the NASA Headquarters Acquisition Division, Code HWG. NASA Graduate Student Researchers fellowships are subject to the provisions of 14 CFR 1265, Government-wide Debarment and Suspension.

Student Evaluation Forms — Students completing their last year in the program will be mailed an evaluation form 60 days prior to termination date. **These forms must be completed and returned to the appropriate NASA Program Administrator prior to program completion.** Students with approved no-cost extensions should return completed forms at the time of fellowship termination. If you do not receive the evaluation form, contact the appropriate Program Administrator or the GSRP Administrator at NASA Headquarters.

NOTE: This form is not intended to be used in lieu of the final administrative report.

Inquiries — Questions concerning the preparation and submission of proposals and the administration of this program are to be directed to the Program Administrators listed on page 9.

Special Note to NASA Graduate Fellows: For over a decade NASA has had the unique opportunity to offer fellowships in aeronautics, space science, space applications, and space technology to promising graduate students nationwide. A critical determinant of continued support for the Graduate Student Researchers Programs depends on you, the student, and the submission of the final administrative report and student evaluation. Program objectives are measured and funding levels are set as a result of these evaluation mechanisms.

Preparation of Proposal

Unsolicited Proposal Requirements — Proposals for the GSRP must be written by the student. Students, however, are strongly encouraged to collaborate with a faculty member and with a potential NASA mentor/advisor to identify a project. Students may enlist the aid of their faculty advisor for guidance, review, and commentary on the written material prior to submission. All proposals must be specific in nature and must be assembled in the following order:

1) Original Signed Cover Sheet
2) Budget Page
3) University Certification for Suspension and Debarment and Drug-Free Workplace
4) Letter of Recommendation
5) Abstract/Description of Proposed Research and Plan of Study
6) Facilities and Resources (Center Applications Only)
7) Personnel

The original and all copies of proposals must be stapled. To facilitate the recycling of proposals after review, proposals should be submitted on plain, white paper only. This precludes the use of cardboard stock, plastic covers, spiral binders, colored paper, etc.

1. Proposal Cover Sheet — The cover sheet must be filled out and signed by the student, faculty advisor, and university official responsible for committing the institution for sponsored research. At least one (1) complete proposal package must contain original signatures. Cover sheets appear in the back of this section.

Proposed research and plan of study must be approved by (1) faculty advisor (see Item II on Proposal Cover Sheet); and (2) the university official responsible for committing the institution for sponsored research (e.g., Director of Research Administration, Director of Sponsored Research) — See Item III on Proposal Cover Sheet. Proposals cannot be processed without the appropriate university approval signatures. Telephone numbers must be included for each approving individual.

2. Budget — A twelve-month budget must include the following: (a) student stipend - $16,000 stipend for twelve months; (b) student allowance - $3,000, may be used for travel and per diem; and (c) university allowance - $3,000, may be used for travel and per diem by the faculty advisor to coordinate and oversee the work of the graduate student. Both allowances may be used for tuition and the purchase of book, supplies, and software. Note: The use of training grant funds for the purchase of nonexpendable equipment is prohibited.

3. Certifications — All application packages must include university certifications to debarment and suspension and drug-free workplace.

4. Letter of Recommendation — The faculty advisor must prepare and sign a one page letter of recommendation on behalf of the student.

5. Abstract/Description of Proposed Research and Plan of Study — On separate pages, develop a summary describing the objectives of the plan of study, including a course schedule by semester/quarter, the proposed research, and the methodology to be used. Students should prepare a full statement, not to exceed five singled-spaced pages, that identifies and relates the key elements of the proposed research and plan of study. Include the proposed starting and completion dates for the graduate student's plan of study and research program and the approximate periods the student and faculty advisor expect to be at the NASA center to conduct activities, if applicable. A detailed schedule and plan must be included in all new proposals.

6. Facilities and Resources (Center Applicants Only) — Students should describe the NASA facilities and resources he/she wishes to use in support of the research and plan of study, including an estimate of any computer time required. Students are strongly encouraged to contact the appropriate facility technical advisor to coordinate research activities.

7. Personnel — The faculty advisor must submit a short biographical sketch that includes name, current position, title, department, university address, phone number, and principal publications. The student must submit a transcript of grades and a summary of education, training, awards, scholarships, significant accomplishments, and any other relevant information.

Submission of Proposal

All applicants must submit one original and nine (9) copies of all materials by **February 1** to the appropriate NASA facility, addressed to the attention of the Program Administrator listed in the Areas of Research Activities at NASA Facilities section of this book.

Applications will be reviewed for selection in March and April. Proposed starting dates for new awards will be no earlier than July 1 and no later than October 1. In general, tenure will begin with normal semester or quarter dates.

Multiple Submissions — When submitting to more than one NASA facility or to the Graduate Student Researchers Program (GSRP), the Underrepresented Minority and Disabled Focus (UMDF) program, and the High Performance Computing and Communications (HPCC) program, separate original application forms, and all required information, including the number of copies necessary to evaluate the proposal, must accompany each submission. A faxed proposal is not considered valid and, therefore, cannot be reviewed.

Renewal Applications — Proposals for renewal are to be submitted to the appropriate Program Administrator by February 1. All applicants should submit an original and nine (9) copies of all materials. The proposal for renewal should include items 1, 2, and 3 in the Preparation of Proposal section of this book on page 12, as well as a brief statement (approximately one page) by the student outlining his or her progress on the research or plan of study. Also included in the renewal package must be a transcript of the student's grades during the preceding year and a one-page evaluation and recommendation signed by the faculty advisor. Proposals cannot be renewed without this information. The starting date for renewals should be on the anniversary of the original grant.

Sponsored Research Office — When submitting applications for new or renewal fellowship awards, include the name, address, and telephone number of the university official responsible for committing the institution for sponsored research (e.g., Director of Research Administration, Director of Sponsored Research).

All application packages must include university certifications to debarment and suspension and drug-free workplace.

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Proposals Due February 1

NASA Graduate Student Researchers Program Proposal Cover Sheet

I. Student Information

Name: (Mr./Ms.)

_____

Last First MI

Birth Date:_____

Birthplace:_____

Home Address:_____

_____

Home Phone:_____

Target Degree: ___MS ___MS/PhD (joint) ___PhD

Discipline:_____

Department:_____

Campus Address:_____

Mail Code:_____

University:_____

Street Address:_____

City, State, ZIP:_____

Campus Phone:_____Fax No.:_____

E-Mail:_____

Undergraduate GPA:_____Out Of:_____

Discipline:_____

Graduate GPA (If Applicable):_____Out Of:_____

Discipline:_____

I certify that I am a citizen of the United States and that I am or will be a full-time graduate student at the university during the period covered by this proposal.

*Signature:*_____*Date:*_____

II. Faculty Advisor Information

Name:_____

Department:_____

Campus Address:_____

Mail Code:_____

University:_____

Street Address:_____

City, State, ZIP:_____

Campus Phone:_____

Fax Number:_____

E-Mail:_____

*Signature:*_____*Date:*_____

III. Official Responsible for Committing Institution

Name:_____

Title:_____

University:_____

Street Address:_____

City, State, ZIP:_____

Campus Phone:_____

*Signature:*_____*Date:*_____

IV. Proposal Information

Type of Proposal: ☐ (1) New ☐ (2) Second Year ☐ (3) Third Year

If Renewal, Designate Grant No.: NGT-_____ Proposed Start or Renewal Date:_____

Expected Graduation Date: _____ Budget Amount_____

Proposal Title _____

_____

Time Spent at NASA Center during past year: _____ weeks _____ months

V. Submission Information

☐ Headquarters

___ Astrophysics
___ Information Systems
___ Solar System Exploration
___ Space Physics
___ Life Sciences
___ Microgravity
___ Earth Sciences

☐ Nasa Centers

___ Ames/Dryden (ARC/DFRF)
___ Goddard (GSFC)
___ Jet Propulsion Lab (JPL)
___ Johnson (JSC)
___ Kennedy (KSC)
___ Langley (LaRC)
___ Lewis (LeRC)
___ Marshall (MSFC)
___ Stennis (SSC)

Center Technical Advisor:

_____

Other Facilities to which this proposal is being submitted:

_____

VI. Proposal Checklist

☐ Original Proposal and 9 Copies
☐ Budget Form
☐ University Certifications
•Debarment and Suspension
•Drug Free Workplace
☐ Signed Advisor Evaluation or Letter of Recommendation
☐ Transcripts

VII. NASA Use Only

☐ Org/Cpys
☐ BdgtFrm
☐ UCert
☐ SAE
☐ T

Privacy Act Statement

General

Pursuant to Public Law 93-579, Privacy Act of 1974, as amended (5U.S.C.§552a), the following information is being provided to persons who are asked to provide information to obtain a NASA Graduate Student fellowship.

Authority

This information is collected under the authority of the National Aeronautics and Space Act. Publication 85-568, as amended, 42 U.S.C. §2451, et. seq.

Purpose and Uses

The information requested on the application form will be used to determine your eligibility for participation in the NASA Graduate Student Researchers Program. The information requested regarding your ethnic/racial/disability status will be used to determine the degree to which members of each ethnic/racial/disability group are being reached by NASA's announcement of this program, and will not affect your application. Additionally, NASA may disclose this information to other organizations or individuals having relationships with NASA, including but not limited to academic organizations, nonprofit organizations, and other governmental agencies, as well as Congressional offices in response to an inquiry made on your behalf. Disclosure may also be made to concerned parties in the course of litigation, to law enforcement agencies, and to other Federal agencies in exchanging information pertinent to an agency decision.

Effects of Nondisclosure

Furnishing the information on the application form is voluntary, but failure to do so may result in NASA's inability to determine eligibility for participation and selection for award in the Graduate Student Researchers Program. However, your application will not be affected if you choose not to provide information on your ethnic, racial, or disability status.

Optional Information Form

In order to determine the degree to which members of each ethnic/racial/disability group are reached by this announcement, NASA requests that the student check the appropriate block(s). Submission of this information is optional and will not affect your application.

☐ **AMERICAN NATIVE OR ALASKAN NATIVE**

☐ **ASIAN**

☐ **BLACK**

☐ **HISPANIC**

☐ **PACIFIC ISLANDER**

☐ **WHITE**

☐ **INDIVIDUAL WITH DISABILITIES***

☐ **MALE**

☐ **FEMALE**

AMERICAN NATIVE OR ALASKAN NATIVE: A person having origins in any of the original peoples of North America and who maintains cultural identification through tribal affiliation or community recognition.
ASIAN: A person having origins in any of the original peoples of East Asia, Southeast Asia or the Indian subcontinent. This area includes, for example, China, India, Indonesia, Japan, Korea and Vietnam.
BLACK, NOT OF HISPANIC ORIGIN: A person having origins in any of the black racial groups of Africa.
HISPANIC: A person of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish culture or origin, regardless of race.
PACIFIC ISLANDER: A person having origins in any of the original peoples of Hawaii; the U.S. Pacific territories of Guam, American Samoa, and the Northern Marinas; the U.S. Trust Territory of Palua; the islands of Micronesia and Melanesia; or the Phillipines.
WHITE, NOT OF HISPANIC ORIGIN: A person having origins in any of the original peoples of Europe, North Africa, or the Middle East.

*An individual having a physical or mental impairment that substantially limits one or more major life activities; who has a record of such impairment; or who is regarded as having such impairment.

NASA Graduate Student Researchers Program
Budget Information

I. Student Stipend (Maximum of $16,000) $_____

II. Student Allowance (Itemize if necessary)

Student Allowance $_____
(Maximum of $3,000)

III. University Allowance (Itemize if necessary)

University Allowance $_____
(Maximum of $3,000)

Total Requested $_____
(Maximum of $22,000)

Section II

1995 NASA Graduate Student Researchers Program

Areas of Research Activities at NASA Facilities

Office of Space Science

NASA Headquarters

The NASA Headquarters Office of Space Science (OSS) supports basic and applied research in space science. The OSS research program includes the development of major space flight missions such as the Advanced X-Ray Astronomical Facility and the Cassini Mission to Saturn, complementary laboratory research and analysis of data from prior missions, and theoretical studies. The scientific disciplines currently being supported are astrophysics, information systems, solar system exploration, and space physics. A brief description of these programs follows.

Contact:
Ms. Dolores Holland
Office of Space Science
Code S
National Aeronautics and Space Administration
Washington, DC 20546-0001
(202) 358-0734

Mail Office of Space Science proposals to:
Graduate Student Researchers Program
Code SPM-20
NASA Headquarters
300 E Street, SW
Washington, DC 20546-0001

Proposals sent by express mail, commercial delivery, or courier to:
Graduate Student Researchers Program
Code SPM-20
Attn: Receiving and Inspections
NASA Headquarters
300 E Street, SW
Washington, DC 20024-3210

Astrophysics

Research in astrophysics is directed toward obtaining a greater understanding of the origin, evolution, and fate of the Universe. Emphasis is placed on the development and implementation of a multiwavelength program of space-based and suborbital missions (airborne, sounding rockets, balloons). Programs that support instrumentation development relevant to future missions, the analysis of data from ongoing and past missions, and on laboratory and theoretical investigations that aid in the interpretation of space-based observations are encouraged.

Information Systems

Information Systems research focuses on providing new capabilities for data archives and directories, computer networking, and high-performance computing in support of space science. The program includes development of generic tools and capabilities, testbed efforts to demonstrate and evaluate advanced technologies for NASA, technology demonstrations, and research efforts in areas such as graphics and visualization, algorithms, data storage technologies, and access methods applicable to the space science disciplines of astrophysics, solar system exploration, and space physics.

Solar System Exploration

Solar system research focuses on the origin, evolution, and current state of the solar system; planetary atmospheres; the origin, evolution, and distribution of life in the universe; and the origin and search for planetary systems. It uses astronomical observations, laboratory experiments, data analysis, and modelling. Activities include studies of planets, rings, moons, asteroids, and comets; analysis of meteorites, cosmic dust, and lunar samples; astronomical studies spanning the full spectrum; the origin, evolution, and search for planetary systems; and the analysis of Viking, Voyager, Magellan, Galileo, Clementine, and ground- and space-based telescopic data.

Space Physics

The space physics program involves investigations of the origin and evolution of plasmas, electromagnetic fields, and energetic particles in space. The studies focus on the Sun, both as an active star and as a source of solar wind and energetic particles; on planetary and cometary magnetospheres; and on the heliosphere and galactic cosmic rays. Measurements are made from balloons, rockets, satellites, and deep space probes. Theory and computer simulations are also supported.

Office of Life and Microgravity Sciences and Applications

NASA Headquarters

The Office of Life and Microgravity Sciences and Applications (OLMSA) leads the nation's efforts in laboratory research using the space environment, improving the quality of life of humans in space and on Earth.

NASA's Office of Life and Microgravity Sciences and Applications coordinates the scientific research and operations of four NASA divisions: The Microgravity Sciences and Applications Division, the Life and Biomedical Sciences and Applications Division, the Flight Systems Division, and the Aerospace Medicine and Occupational Health Division. Discipline research is conducted within the two research divisions: Microgravity Sciences and Applications Division and the Life and Biomedical Sciences and Applications Division.

Contact:
Ms. Georgia A. LeSane
Office of Life and Microgravity Sciences and Applications
Code UP
NASA Headquarters
Washington, DC 20546-0001
(202) 358-0123.

Mail Office of Life and Microgravity Sciences and Applications proposals to:
Graduate Student Researchers Program
Code UP
NASA Headquarters
300 E Street, SW
Washington DC 20546-0001

Proposals sent by express mail, commercial delivery, or courier to:
Graduate Student Researchers Program
Code UP
ATTN: Receiving and Inspection
NASA Headquarters
300 E Street, SW
Washington DC 20024-3210

Microgravity Science and Applications

The objective of the Microgravity Sciences and Applications Division is to explore and understand the effects of microgravity on physical, chemical, and biochemical processes in a microgravity environment. This objective includes the establishment of a microgravity science institute in space, the International Space Station, to provide a flight facility for conducting long-duration microgravity research. The ongoing research program emphasizes these scientific disciplines: biotechnology, combustion science, fluid physics, materials science, and benchmark science. Benchmark science research encompasses research on transient and equilibrium critical phenomena, as well as other thermophysical measurements of interest in condensed matter and gravitational physics. Research in materials science includes studying the relationships between the processing properties and structure of materials. Of particular interest is understanding the role of gravity in the processing of electronic and photonic materials; metals, alloys, and composites; glasses and ceramics; and polymers. The primary focus of the microgravity program in biotechnology is to identify and quantitatively understand cause-and-effect relationships between gravitational forces and experiment outcomes in the fundamental processes controlling protein crystal growth and cell/tissue culturing. The research in fluid physics and transport phenomena concentrates in areas where fundamental behavior is limited to or affected by the presence of gravity, and where low gravity experiments allow insight into that behavior. The combustion research centers on improving the understanding of the process of ignition, propagation, and extinction of various types of flames under low-gravity conditions, and isolation phenomena that tend to be obscured by buoyancy effects accompanying combustion under normal gravity conditions. The investigations are conducted by universities, industry, and Government researchers using both ground-based and flight experiments.

Life and Biomedical Sciences and Applications

The Life and Biomedical Sciences and Applications Division involves multidisciplinary research areas in the biomedical and biological sciences. Research focuses on: space biology, space physiology, and countermeasures; radiation health; environmental health; human factors; and advanced life support systems. The program includes ground-based research and technology development and the flight of equipment and instruments for human, animal, plant, and cellular experiments on board the Space Shuttle, in the Spacelab laboratory module, and on other Earth-orbiting spacecraft.

Mission to Planet Earth: Understanding Global Environmental Change

NASA Headquarters

NASA's Mission to Planet Earth (MTPE) studies the Earth's environment—air, water, land, living matter, and their interactions—to better understand global climate changes. Mission to Planet Earth uses the unique perspective of studying the Earth from space to see how our environment is changing and how human activities may contribute to that change.

Contact:
Dr. Ghassem Asrar
Office of Mission to Planet Earth
Code YS
National Aeronautics and Space Administration
Washington, DC 20546-0001
(202) 358-0273

Mail Office of Mission to Planet Earth proposals to:
Graduate Student Researchers Program
Code YSP-44
NASA Headquarters
300 E Street, SW
Washington, DC 20546-0001

Proposals sent by express mail commercial delivery, or courier, send to:
Graduate Student Researchers Program
Code YSP-44
Attn: Receiving and Inspections
NASA Headquarters
300 E Street, SW
Washington, DC 20024-3210

Phase I of Mission to Planet Earth— composed of ongoing and near-term missions, and small, focused missions called Earth Probes — includes more than 30 missions prior to 1998 to study various aspects of the Earth system. These missions will pave the way for the broader focus and coverage planned as part of Phase II — the Earth Observing System (EOS) — slated for later this decade.

Scientific investigations contributing to the EOS already are well underway, adding to our knowledge of the Earth and its climate system. Individually and as teams, EOS scientists are forging interdisciplinary collaborations and training the next generation of Earth system scientists.

Ongoing and Near-term Missions — To gain near-term information on global change, NASA has an ongoing program that provides important data sets for research today. These missions include satellites such as the Upper Atmosphere Research Satellite (UARS), launched in 1991 to study the chemistry of the upper atmosphere, and the joint U.S./French Ocean Topography Experiment (TOPEX/POSEIDON), launched in 1992 to study ocean circulation.

In addition to satellite missions, NASA also conducts missions onboard the Space Shuttle, such as the Atmospheric Laboratory for Applications and Science (ATLAS), which investigates how both the sun and products of industrial and agricultural activities on Earth influence our planet. NASA also cooperates closely with other nations, providing instruments for flight on international spacecraft and exchanging data and analyses.

Earth Probes — The Earth Probes program, also part of Phase I, includes smaller, specialized U.S. satellites that will be launched before and possibly during the Phase II EOS space-flight period. Instruments on Earth Probe satellites will be used for investigations requiring different orbits and measurement strategy than those of the EOS platforms which require congruent and synergistic observations. Missions planned under this program include studies of ocean surface winds, tropical precipitation, and ozone.

The Earth Observing System — Phase II of Mission to Planet Earth is the Earth Observing System (EOS), a series of 17 spacecraft planned for launch into near-Earth orbit. As the core of MTPE, the EOS instruments will make long-term, calibrated measurements of the interrelated elements of the Earth system. Together, these satellites will monitor a wide array of physical, chemical, and biological processes that influence Earth as a complete and integrated system on a global scale.

Each EOS spacecraft will focus on a different aspect of global climate change and different aspects of complex interactions within the Earth's environment. The EOS schedule targets a minimum of 15 years of continuous and calibrated Earth observations. The first satellite in the series is scheduled for launch in 1998, and will observe the Earth's surface, clouds, aerosols, and radiation balance (i.e., biosphere-atmosphere interactions). Satellites dedicated to other aspects of the Earth system will follow this mission.

To allow wide use of information from MTPE, NASA is developing the unique EOS Data and Information System (EOSDIS). EOSDIS will process, store, and distribute critical information to thousands of national and international scientists and other users, enabling quick and easy access to data and encouraging cooperative use of global climate change research results for establishing environmental policy decisions by the social and economic scientists and policy makers.

Studies to Enhance Our Understanding — Mission to Planet Earth will play a critical role in the national and international efforts to understand the global environment, enhancing our awareness of ongoing natural and human-induced global changes. While global data gathered from space are crucial to understanding the Earth system as a whole, these data are only part of the process. NASA and other Federal agencies also conduct aircraft and surface-based observations, as well as laboratory experiments and modelling. These efforts together will help translate information into knowledge required to understand how Earth functions as a system, and how its environment is changing.

Through better comprehension of the causes of global change, policy makers and the public will be able to address potential large-scale environmental problems. This data will enable us to make careful decisions regarding the long-term welfare of our home planet.

Ames Research Center

GSRP Program Administrator:

Ms. Meredith Moore
Mail Stop 241-3
NASA Ames Research Center
Moffett Field, CA 94035
(415) 604-5624

The Ames Research Center conducts research activities, technology programs, and flight projects that advance the nation's capabilities in civilian military aeronautics, space sciences, and space applications. This diverse program at Ames is organized into aeronautics, aerophysics, space research, and life sciences.

In preparing a proposal for a fellowship at Ames Research Center, prior collaboration with an Ames researcher is mandatory. A suggested point of contact is listed with each research topic for which a student may apply.

Aeronautics — In aeronautics, Ames concentrates on rotorcraft and powered lift aircraft technology, short-haul aircraft and helicopter technology, fluid mechanics, experimental aerodynamics, flight simulation, flight systems research, and human factors.

Contact:
Joe Totah
(415) 604-5057

Experimental Aerodynamics — Low-speed testing in the 12x24-, 24x37-, and 2x3-meter wind tunnels. Development of computational/empirical prediction methods for powered lift and conventional lift configurations. Prediction and analysis of acoustic characteristics of aircraft configurations and wind tunnel facilities. Development and application of non-intrusive measurement techniques.

Contact:
Dennis Riddle
(415) 604-6677

Computer Vision — Computer vision and image understanding techniques are being applied to the navigation of rotorcraft and aircraft during low-altitude flight, landing and taxing. The techniques are quite general and can be used in the autonomous guidance of other types of vehicles.

Contact:
Banavar Sridhar
(415) 604-5450

Flight Research — Simulation investigations, guidance and navigation, aircraft automation, flight dynamics, advanced control theory (helicopter V/STOL applications).

Contact:
Ed Aiken
(415) 604-5009
Flight Dynamics and
Controls Research

Human Factors — Crew performance, aviation safety, aircraft operating systems advanced spatial displays and instruments, virtual environments, high-fidelity simulation-based human performance assessment, operator interfaces to intelligent systems and advanced automation.

Contact:
Mike Shafto
(415) 604-6170

Aircraft Conceptual Design — Development of aircraft design synthesis techniques that incorporate optimization routines, expert system concepts, and graphical user interfaces on a system of networked computer workstations. Studies are broad in nature, encompassing the subsonic to hypersonic speed ranges, and including such concepts as rotocraft, fixed-wing, and transatmospheric vehicles. Analyses include a total transportation systems approach and consider market requirements and economics.

Contact:
Thomas L. Galloway
(415) 604-6181

Rotorcraft Aeromechanics — Experimental and theoretical research programs to improve performance, vibration, and noise of advanced rotorcraft. Studies include basic investigations of the aerodynamics, dynamics, and acoustics of rotor systems for helicopters, tilt rotors, and other advanced configurations. Experiments are performed in the Ames 2x3-meter wind tunnel and in the National Full-Scale Aerodynamics Complex, including the 12x24-meter wind tunnel.

Contact:
William Warmbrodt
(415) 604-5642

Engineering and Technical Services — In engineering and technical services, Ames concentrates on facility engineering, telecommunications, and administrative computing.

Contact:
Jim Hart
(415) 604-6251

Telecommunications — Engineering and advanced systems capability for voice, video, data communications, computer networking, and networking research.

Contact:
Jim Hart
(415) 604-6251

Artificial Intelligence — Basic and applied research is conducted in the framework of aerospace domains including space transportation, space science, and aeronautics. Three research areas are emphasized: Planning (including both goal- and resources-driven approaches), machine learning (the entire spectrum from empirical to knowledge-intensive), and the design of and reasoning about large-scale physical systems (including work in knowledge acquisition, knowledge base maintenance, and all applications to the design process).

Contact:
Peter Friedland
(415) 604-4277

Intelligent Systems Technology — Research is conducted in intelligent computational systems for aerospace missions. Activities address autonomous operation, evolutionary capability, real-time performance, and adaptivity. Current research programs include parallel systems, fault management, open computer architectures, analog optical processors for pattern recognition and control tasks, and neural networks. There is also an emphasis on integrating technologies into advanced distributed, heterogeneous systems and developing tools for performance evaluation.

Contact:
Charles Jorgensen
(415) 604-6725

Aerophysics

Aerothermodynamics — Provides aerothermodynamic flow-field computational capability to analyze and design advanced space transportation concepts. Also provides the analytical and turbulence chemistry models required to compute the viscous/finite-rate flow field and to predict radiation heating to conceptual aeroassisted orbital vehicles.

Contact:
Thomas A. Edwards
(415) 604-4465

Aerothermal Materials and Structures — Develops lightweight reusable ceramics and carbon-carbon Thermal Protection Systems (TPS) for transient, high-velocity atmospheric penetration and develops expendable TPS for planetary probes.

Contact:
Tina L. Panonti
(415) 604-6757

Computational Materials Science — Develops verified methods for predicting material properties and reactions by extending interaction models of interatomic and molecular behavior to the macroscopic level.

Contact:
Steven R. Langhoff
(415) 604-6213

High Performance Computing — Current advances in high performance computing are coming from novel computer architectures such as parallel processors, vector processors, and heterogeneous networks of computers. The suitability of these architectures to solving problems of interest to NASA and the development of new architectures that efficiently solve these problems is the objective of this research. Of particular interest is the investigation of architectures to solve problems arising in computational fluid dynamics as governed by the Navier-Stokes equations. These investigations could include software issues as well as hardware issues because the ultimate goal is to provide the researcher at Ames with improved computational resources. Current computational resources include CRAY C90's, iPSC/860, Paragon, Connection Machine 5, and IBM SP2, as well as a network with powerful workstations and superminis.

Contact:
Kenneth Stevens, Jr.
(415) 604-5649

Scientific Visualization and Interactive Computer Graphics — This research is aimed at the creation of highly interactive and visual environment for scientists who are developing computer simulations of physics or who are required to analyze large 3-D datasets. Current research is being done using Silicon Graphics Workstation connected to supercomputers.

Contact:
Tom Lasinski
(415) 604-4405

Wind Tunnel Composite Applications — Transfer to composite technology to specific application for the Aerodynamics Division wind tunnels. Areas of application include: axial flow compressor blading, gaging for model support assemblies, and siting assemblies for model supports. Research opportunity exists to develop a computer design code for evaluating and tailoring composite structures to the specific application. Opportunity also exists in developing fabrication and QA techniques.

Contact:
Daniel Petroff
(415) 604-5850

Control Algorithm for Wind Tunnel Support Systems — Develop and verify the control algorithm and software for a six-degree-of-freedom Captive Trajectory System. The system will be used in wind tunnel testing to evaluate the aerodynamics of separating vehicles. The task involves using existing support systems to accurately and safely position the vehicles for acquisition of data, specifying the control hardware, writing the software, and verifying the software.

Contact:
Daniel Petroff
(415) 604-5850

Computational Fluid Dynamics — Theoretical research in fluid dynamics using the Euler and the Navier-Stokes equations, both compressible and incompressible. Includes research on basis equation formulations, algorithm development, and code efficiency, as well as the physics of laminar and turbulent flow fields.

Contact:
Thomas H. Pulliam
(415) 604-6417

Turbulence Physics — Study of the fundamental physics of turbulent and transitional flows through numerical simulations. Studies include developing numerical algorithms suitable for direct and large-eddy simulations of turbulent flows, developing tools for analyzing computer-generated databases, and developing turbulence models for engineering applications.

Contact:
Nagi Mansour
(415) 604-6420

Joseph Marvin
(415) 604-5390

Advanced Instrumentation — Instrumentation techniques are being developed to measure both mean and fluctuating quantities in complex turbulent flow fields. These include three-dimensional LDV systems, rapid scanning LDV systems, multiple hot wire arrays for spatial and time-dependent data, an holography and methods to measure surface skin friction.

Contact:
Joseph G. Marvin
(415) 604-5390

Unsteady Viscous Flows — Research areas under investigation include dynamic stall control, drag reduction of airfoils and wings, and the control of supersonic transition. Experimental, computational, and theoretical tools are developed and used in both basic and applied studies.

Contact:
Sanford Davis
(415) 604-4197

Applied Computational Fluid Dynamics — This area deals with the development of new computational methodology involving aerodynamic and/or fluid dynamic application associated with incompressible, subsonic, transonic, supersonic, or hypersonic flight speeds. Computer codes are constructed and evaluated for applications associated with aircraft or aircraft component aerodynamics, rotorcraft aerodynamics, high-angle-of-attack flows, unsteady flows, and flows with aeroelastic effects.

Contact:
Terry L. Holst
(415) 604-6032

Hypersonics — This area deals with the development of new computational methodology involving aerodynamic and/or fluid dynamic applications associated with hypersonic flight speeds. The physical aspects of this flight regime require emphasis on algorithms/codes with accurate heat transfer prediction capabilities, strong shock capturing abilities and chemical equilibrium and nonequilibrium models for air.

Contact:
George S. Deiwert
(415) 604-6198

Space Sciences

In space science, Ames concentrates on research directed at enhancing understanding of the origins, evolution, current state of the universe, the solar system, the Earth, and life. Principal efforts focus on a multidisciplinary approach to research activities in space science and life science. As a federal research laboratory with strong ties to the universities and other government laboratory, Ames brings to the task a small research team approach that applies the skills and interests of the broader science community to these fundamental issues. Particular emphasis in space science is placed on infrared science and climatology, earth airborne sciences, and the development and application of selected flight projects and areas of space technology relevant to those research needs. The following are ongoing areas of space science research.

Infrared Astronomy Projects and Technology Development — Development is conducted for the Stratospheric Observatory for Infrared Astronomy (SOFIA). Current research is focused on the integration of the design tools to allow full system simulation prior to SOFIA operation. The technology tasks include optics, detectors, and cryogenics. Advanced mirrors materials are studied in a unique low-temperature facility. Multi-element IR detector arrays are developed and characterized for space astronomy. Advanced efficiency cooling techniques are developed for space.

Contact:
Chris Wiltsee
(415) 604-5917

Craig McCreight
(415) 604-6549

Theoretical Astrophysics — Research is being conducted on star formation, circumstellar disks, the physics and chemistry of the interstellar medium, and the formation and dynamical evolution of galaxies. Theoretical models involve the application of computational techniques to problems in astrophysical gasdynamics, radiative transfer, and many-body systems.

Contact:
Pat Cassen
(415) 604-5597

Space Projects — Development of systems and scientific instrumentation with which to explore space and to study biological effects of weightlessness. This includes development of a biological research capability with plants and animals on Space Station Freedom, development of instrumentation to be used on interplanetary flights and atmospheric penetrations, management of the ongoing flights of Galileo's Probe to Jupiter's atmosphere, of the Pioneer Venus Orbiter about its planet, and of the Pioneers 10 and 11 departing the solar system, and the study and advocacy of scientific instrumentation for future spacecraft.

Planetary Science — Research in this area includes atmospheric, chemical, radiative, and dynamic models, remote sensing of planetary ring dynamics.

Contact:
Pat Cassen
(415) 604-5597

Solar System Exploration — Solar system exploration research defines flight experiments and related data bases and develops analytical concepts and prototype flight instrumentation for the extraterrestrial study of exobiology (history of the biogenic elements, chemical evolution, and origin and early evolution of life). Particular emphasis is placed on the biogenic elements (C, H, N, O, P, S) and their compounds as they relate to the composition and physical characteristics of the various bodies and materials of the solar system, such as cometary nuclei and comae and planetary atmospheres and surfaces. Experiment and instrument definition studies for Mars, Space Station Freedom microgravity facilities, interplanetary dust particles, and comet sample return are currently being conducted.

Contact:
Glenn Carle
(415) 604-5765

Life Sciences

In life sciences, Ames concentrates on biomedicine (the effects of the space environment on man and other organisms), extraterrestrial research, and biosystems (the ability to support man in the space environment).

Advanced Life Support — Advanced Life Support at Ames concentrates on the research and the development of technologies required to support human life in space on long duration missions, for example, transits to Mars and the establishment of bases on the Moon and Mars. The focuses of the work are on technologies for regeneration of life support materials (water, air, and food) through both physical-chemical and bioregenerative processes, and on new concepts in space suites and personal life support systems. The programs have strong ties to universities and industry, and utilize a multidisciplinary approach to scientific, engineering, and development issues.

Contact:
William Berry
(415) 604-4930

Physical-Chemical Closed-Loop Life Support — Physical-chemical life support includes modeling and simulation, system analysis, and the development of devices and test-beds. Sub-systems studied include those for: 1) air regeneration, including CO_2 removal and reduction, and water electrolysis; 2) waste management and processing, including waste stream separation and various methods of waste oxidation, including incineration, wet oxidation, and super-critical water oxidation; 3) water purification and regeneration; and 4) atmospheric contamination removal and control.

Contact:
Theodore Wydeven
(415) 604-5738

Edwin Force
(415) 604-3755

Bioregenerative Life Support — The focus of the bioregenerative life support area is on the use of plants and algae as processors and producers of regenerated air, water, and food in the space environment. Areas stressed include: 1) identification of environmental conditions required for maximal crop plant productivity; 2) development of biological methods for waste water treatment; 3) modeling, simulation, and control of system operation; 4) development of flight hardware for evaluation and qualification of crop productivity in space; and 5) application of technologies to develop devices for astronauts' diet enhancement.

Contact:
Robert MacElroy
(415) 604-5573

David Bubenheim
(415) 604-3209

Extravehicular Systems Research and Technology — The program primarily focuses on manned systems for advanced zero-g, lunar, and mars exploration. Elements include: pressure suit, gloves, portable life support, and control/display interfaces with telerobotic EVA work aids. Technology development is required in environmental control systems, controls and displays, suit mobility joints and materials, and in diagnostics, maintenance, and checkout support systems. Advances are required to enable safe, routine, and highly productive manned EVA on future missions.

Contact:
Bruce Webbon
(415) 604-6646

Space Biology — Space biology research uses the space environment, particularly weightlessness, and ground-based space flight simulations to investigate basic scientific questions about the role of gravity in present-day terrestrial biology and the role it has played during the evolution of living systems. The research is divided into the disciplinary areas of biological adaptation, gravity sensing, and devel

opmental biology. Experiments are carried out at the subcellular, cellular, tissue, organ, and system levels in differing organisms of the five kingdoms of life.

Contact:
Emily Holton
(415) 604-5471

Ecosystem Science and Technology — Interdisciplinary research in ecosystem science and technology looks at the role of life in modulating the complex cycling of materials and energy throughout the biosphere. Intact ecosystems, with particular emphasis on temperate and tropical forests, are examined by remote sensing from aircraft and spacecraft and by field site visits, with subsequent laboratory and computer analysis of the data gathered.

Contact:
Jim Lawless
(415) 604-5900

Neurosciences — Research in neurosciences examines how the nervous system adapts to environmental conditions encountered in space, how adaptive processes can be facilitated, and how human productivity and reliability can be enhanced. To elucidate mechanisms underlying adaptation, neurosciences research includes neurochemistry, neuroanatomy, neurophysiology, vestibular physiology, psychophysiology, and experimental and physiological psychology. State-of-the-art facilities include human and animal centrifuges, linear motion devices, an animal care facility, a human bed-rest facility, and NASA's Vestibular Research Facility.

Contact:
Mal Cohen
(415) 604-6441

Space Physiology — Multidisciplinary research in space physiology emphasizes the effects of microgravity on cardiovascular, musculoskeletal, and regulatory systems of humans and animals. Actual microgravity and ground-based models of simulated microgravity are used to investigate basic mechanisms of adaptation of space and readaptation to Earth. Physiological, biomechanical, cellular, and biochemical factors are also studied to develop appropriate countermeasures for maintaining health, well-being, and performance of humans in space.

Contact:
Alan Hargens
(415) 604-5746

Planetary Biology — Interdisciplinary research in planetary biology is aimed at understanding the factors in cosmic, solar system, and planetary development that have influenced the origin, distribution, and evolution of life in the universe and the course of interaction between biota and earth's surface environments. Hypotheses are formulated and tested by two major approaches: (1) analysis of samples, such as cosmic dust, planetary materials, ancient and recent rocks and sediments, and extant microorganisms, and (2) use of simulation, ranging from laboratory experiments to computer modeling.

Contact:
Sherwood Chang
(415) 604-5733

Earth System Science

In Earth System Science, the focus at Ames is to perform and lead research within the disciplines of atmospheric and ecosystem science, with particular emphasis on how the biosphere and atmosphere interact to influence the evolution of the global system on all time scales.

Earth Atmospheric Chemistry and Dynamics — Research in this area includes the development of models and the use of airborne platforms and spacecraft to study chemical and transport processes that determine atmospheric composition, dynamics, and climate. These processes include the effects of natural and man-made perturbations.

Contact:
Phil Russell
(415) 604-5404

Ecosystem Science — Research in this area is directed to advanced understanding of the physical and chemical processes of biogeochemical cycling and ecosystem dynamics of terrestrial and aquatic ecosystems through the utilization of aerospace technology.
Contact:
David Peterson
(415) 604-5899

Hugh L. Dryden Flight Research Center

GSRP Program Administrator:
Ms. Meredith Moore
Mail Stop 241-3
NASA Ames Research Center
Moffett Field, CA 94035
(415) 604-5624

The research program at the Dryden Flight Research Facility, Edwards Air Force Base, California, is administered by the Ames Research Center. The program includes most engineering disciplines in aeronautics, with emphasis on flight systems integration and flight dynamics. The following descriptions identify the current activities relevant to the Dryden program for which qualified students may apply.

Advanced Digital Flight Control — Modeling, simulation, and flight test of distributed control systems. Design criteria and methods for unconventional vehicles, including decoupling of asymmetrical airplanes and stabilization of highly unstable airframes.

Contact:
Joseph Gera
(805) 258-3795

Flight Systems — Engineering aspects of the formulation, design, development, fabrication, evaluation, and calibration of flight control, avionic, and instrumentation systems used onboard complex, highly integrated flight research vehicles. Work with fault tolerant redundant microprocessor-based control systems, microprocessor-based measurement systems, transducers, actuators, techniques for system safety, and hazard analysis.

Contact:
Vince Chacon
(805) 258-3791

Flight Dynamics — Pilot/aircraft interaction with advanced control systems and displays, assessing and predicting aircraft controllability, developing flying qualities criteria, parameter estimation, and mathematical model structure determination.

Contact:
Robert Clarke
(805) 258-3799

Flight Test Measurement and Instrumentation — Flow measurement, skin friction drag, fuel flow, integrated vehicle motion measurements, space positioning, airframe deflection, sensor and transducer miniaturization, and digital data processing.

Contact:
Rodney Bogue
(805) 258-3193

Fluid Mechanics and Physics — Laminar and turbulent drag reduction configuration aerodynamics, experimental methods, wing/body aerodynamics, full-scale Reynolds number test technology, high angle of attack aerodynamics, applied mathematics, and atmospheric processes.

Contact:
Robert Meyers
(805) 258-3707

Propulsion/Performance — Propulsion controls, integrated propulsion/airframe systems, and vehicle performance measurement.

Contact:
Larry Myers
(805) 258-3698

Structural Dynamics — Aerostructural modeling, vibration and flutter analyses/predictions, aircraft flutter, flight envelope expansion, ground vibration and inertia testing, aeroservo/elasticity, active control of structural resonances, and advanced flight test technique development.

Contact:
Mike Kehoe
(805) 258-3708

Aircraft Automation — Knowledge-based systems development, verification and validation of knowledge-based systems, neural networks, heuristic controllers, knowledge-based acquisition/implementation, maneuver controllers, performance optimization, guidance, pilot-vehicle interface, and robotic aircraft.

Contact:
Lee Duke
(805) 258-3802

Integrated Test Systems and Aircraft Simulation — Development of Integrated System Test equipment, including aircraft/simulation interface equipment, automated test equipment, and applied artificial intelligence techniques for diagnosis and control. Flight simulation development for advanced aircraft systems in aerodynamic, propulsion, and flight control modeling.

Contact:
Dale Mackall
(805) 258-3408

Goddard Space Flight Center

Program Administrator

Dr. Gerald Soffen
Director, University Programs
Code 160
NASA Goddard Space Flight Center
Greenbelt, MD 20771
(301) 286-9690

The mission of the Goddard Space Flight Center is to expand knowledge of the Earth and its environment, the solar system, and the universe through observations from space. To assure that our nation maintains leadership in this endeavor, we are committed to excellence in scientific investigation, in the development and operation of space systems, and in the advancement of essential technologies.

Graduate Student Researchers Program opportunities are available in the Space Sciences Directorate, the Earth Sciences Directorate, the Engineering Directorate, and the Mission Operations and Data Systems Directorate. Research opportunities at Goddard's two remote facilities—the Goddard Institute for Space Studies in New York City and the Wallops Flight Facility on Wallops Island, VA—are included in these listings. ***Qualified applicants are strongly encouraged to explore areas of interests with the contacts listed here prior to submitting a proposal.*** *All proposals should come to the program office in Greenbelt, MD.*

Space Sciences Directorate

The Space Sciences Directorate plays a leading role in conceiving and developing instruments and missions for the scientific exploration of space through its three research organizations:

— Laboratory for High Energy Astrophysics
— Laboratory for Astronomy and Solar Physics
— Laboratory for Extraterrestrial Physics

The Orbiting Satellites project in the Directorate manages operating scientific spacecraft which were developed by Goddard. The Directorate's Space Sciences Data Operations Office designs and develops long-term archival systems and provides for public access to the archives.

Laboratory for High Energy Astrophysics — High energy astrophysics is the study of those physical processes in an astronomical setting that typically occur at energies in excess of the few million degree temperatures characteristic of stellar photospheres. Continuum X-ray and gamma ray emission is produced by the interaction of charged particles with matter and electromagnetic fields, so that the study of such radiation is the study of these interactions in remote settings, while cosmic ray studies sample the charged particle distributions locally. Discrete lines in the X-ray and gamma ray spectra can be related to extreme environments in compact objects (ultra-high magnetic fields, for example), and can trace nucleosynthesis through nuclear or atomic transitions. In the Laboratory for High Energy Astrophysics, a broad program of experimental and theoretical research is conducted in all phases of astrophysics that deal with cosmic particles and the high energy quanta

that their interactions produce. Experiments that measure cosmic X-rays, gamma rays, and charged particles are designed built, and flown on balloons, rockets, Earth satellites, and deep space probes. The resulting data are analyzed and interpreted by laboratory scientists and their associates. In so studying the physics of solar, stellar, galactic, and metagalactic high energy processes, theoretical models of the origins and histories of these particles and quanta are developed.

Contact:
N. White
(301) 286-8443
Archival X-ray and gamma ray data analysis

E.A. Boldt
(301) 286-5853
Cosmological X-ray studies

J. Swank
(301) 286-9167
Stellar X-ray sources

R. Mushotzky
(301) 286-7579
Extragalactic X-ray sources

C.E. Fichtel
(301) 286-6281
High Energy (>20MeV) gamma rays

T.L. Cline
(301) 286-8375
Low energy (0.02 - 20 MeV) gamma rays

J.F. Ormes
(301) 286-8801
Cosmic Rays

R. Ramaty
(301) 286-8715
Theoretical studies

Laboratory for Astronomy and Solar Physics — The Laboratory for Astronomy and Solar Physics conducts a broad program of research in both observational and theoretical astronomy and solar physics. Observational programs, including technology and instrumentation development, span the spectral range from X-ray to radio wavelengths. Astrophysical phenomena of the Sun and stars are studied with emphasis on their structure, origin, and evolution. Investigations of the gross dynamics and transient properties of the atmospheres of the Sun and other stars are carried out, emphasizing phenomena revealed by spectroscopic observations made above the Earth's atmosphere and correlated with ground-based observations.

The interstellar medium is studied, both on a large scale to elucidate the distribution of mass and luminosity in the Galaxy, and in individual clouds to probe processes of stellar formation, grain characteristics, and cloud chemistry. The Milky Way galaxy, other galaxies, quasars, and radio galaxies are studied, with special emphasis on those parameters bearing on the present structure of the universe as well as on its origin, age, and future. The cosmic microwave and infrared background radiations are also studied to probe the early history of the universe. Additional research includes investigations of the chemical history of the Solar System and the nature of solar wind interactions with comets.

Data of interest to laboratory scientists are currently being obtained from the International Ultraviolet Explorer (IUE) and the Goddard High Resolution Spectrograph (GHRS)on the Hubble Space Telescope, archival data from these missions, the Cosmic Background Explorer (COBE), the Solar Maximum Mission (SMM), the Infrared Astronomical Satellite (IRAS) and the Ultraviolet Imaging Telescope (UIT) on the Astro Mission. Soon the Space Telescope Imaging Spectrograph (STIS) should produce diffraction-limited spectral imagery when installed in the Hubble Space Telescope, and the Solar and Heliospheric Observatory (SOHO) will provide new opportunities for study of the solar corona.

Two missions, the Far Ultraviolet Spectroscopic Explorer (FUSE), and the High Energy Solar Physics (HESP) mission, are currently being studied. Conceptual and technology studies for infrared array cameras on various platforms including the Space Infrared Telescope Facility (SIRTF) are also in progress. Active suborbital observing programs are carried out from ground-based, airborne, balloon-borne, and rocket-borne instruments.

Contact:
Charles Bennett
(301) 286-3902
Infrared Astronomy

Susan Neff
(301) 286-5137
UV-Optical Astronomy

Richard Fisher
(301) 286-5682
Solar Physics

Michael Hauser
(301) 286-8701
Laboratory Chief

Laboratory for Extraterrestrial Physics — The Laboratory performs research on the physical properties and dynamical processes active in solar, planetary, and interplanetary media. The chemistry and physics of planetary atmospheres, the solar atmosphere, planetary magnetospheres, comets, and condensed solar system matter, including meteorites, asteroids, and planets are studied.

A major effort is the analysis of data from Voyagers 1 and 2, SAMPEX, ULYSSES, FAST, IMP-8, ICE, GEOTAIL, and suborbital rocket payloads. This research focuses on plasma studies, including magnetic fields, radio waves, and electron and ion plasmas that are located in planetary magnetospheres. Extensive preparations are underway for the launches of the WIND, POLAR, and CLUSTER spacecraft, for future work in space plasma physics, and includes strong participation in theory and ground based investigations. The Laboratory is also preparing for the Composite Infrared Spectrometer and Plasma Spectrometer investigations on the Cassini mission to be launched to Saturn, and for investigations on the Mars Global Surveyor spacecraft. A strong theoretical effort exists which includes the study of solar wind turbulence, the modelling of the magnetosphere, the non-linear dynamics of the magnetosphere and the development of the next generation of adaptive grid MHD simulation codes. Infrared spectra of the outer planets are also studied to deduce atmospheric properties. In infrared astronomy, the Laboratory studies planetary atmospheres, and the infrared solar spectrum. Studies on molecules and chemical reactions of astrophysical and aeronomic interest are also conducted in the special facilities of the laboratories. Instrumentation includes various cryogenic grating and Fabry-perot spectrometers, a laser heterodyne spectrometer, and in-house developed instruments for use on the ground, on spacecraft, on aircraft, and on balloons.

Contact:
Joseph A. Nuth
(301) 286-9467
Astrochemistry

Keith W. Ogilvie
(301)286-5904
Interplanetary Physics

L. Drake Deming
(301) 286-6519
Planetary Atmospheres, Infrared Spectroscopy & Molecular Structure

Steven A. Curtis
(301) 286-9188
Planetary Magnetospheres

James A. Slavin
(301) 286-5839
Electrodynamics

National Space Science Data Center — The center offers exceptional opportunities for computer scientists seeking to apply advanced data systems concepts to NASA's challenging space data problems. Areas of interest include on-line Data Base Management Systems, heterogeneous multisource data bases, transaction management, and data base logic.

Research is conducted on advanced data systems for scientific data management using expert systems, data base machines, mass storage systems and computer visualization, and on developing interactive scientific data systems integrating data archiving, catalogue, retrieval, data and image manipulation, and transmission techniques into distributed systems.

Contact:
James Green
(301) 286-4643
Scientific Data Systems

Joseph King
(301) 286-7355
Mass Data Storage and Data Media

Greg Goucher
(301) 286-9884
Computer Visualization

Barry Jacobs
(301) 286-5661
Data Base Management

James Thieman
(301) 286-9790
Interoperable Information Systems

Earth Sciences Directorate

The mission of the Earth Sciences Directorate is to provide leadership in achieving improved observations and understanding of global Earth systems processes and trends through the development and utilization of space technologies. The Earth systems being studied range from the deep interior (the core and the source of the magnetic field, the mantle, and its properties), through the surface (e.g., plate motion, soil formation, biospheric and hydrospheric processes, and ice studies), to the atmosphere (gaseous chemistry, trends, climate models), and beyond (the ionosphere, solar studies, and planetology). The Directorate keeps an aggressive basic and applied research program operating at a level which ensures strong vision and leadership while fulfilling its responsibilities encompassed by NASA and U.S. programs in Earth sciences.

Contact:
Louis Walter
(301) 286-8551

Global Change Data Center — The Global Change Data Center (GCDC) provides Earth science data operations and archive management to key Earth science flight missions. The Center ensures that data within the archive are readily accessible through the Goddard Distributed Active Archive Center (GSFC/DAAC) and

operates key advanced data systems to support NASA flight missions. The GCDC interacts closely with the scientific community being served.

The Goddard DAAC Facility is responsible for the acquisition, archiving, and dissemination of scientific data from specific Earth science missions. It develops, implements, and operates the GSFC/DAAC data system; interfaces the GSFC/DAAC with the other NASA DAAC systems in order to provide timely access to archived data and information; provides special services for the Earth science communities; performs scientific analysis; and generates multi-disciplinary data bases. It also oversees management of the archival systems and facilities of the GCDC; maintains the archive and preserves valuable information content against physical deterioration of the storage media; and produces a regular publication promoting and informing the science user community of its archive contents and services.

The Earth Science Data Operations Facility works closely with flight project personnel in data system planning and utilization, and develops and implements the capability to support Earth sciences mission needs. The Facility is responsible for supporting instrument algorithm development and operational project data set production systems; developing such systems for specific NASA flight projects such as the Earth Probes; and developing nationally accessible advanced data projects for the area of Earth science. It conducts research in advanced computer science methodologies for application to science data operations, and oversees management of the computer systems needed to process project data systems.

Contact:
Stephen Wharton
(301) 286-9041
Global Change Data Center

Paul Chan
(301) 286-0828
Goddard DAAC Facility

Richard Kiang
(301) 286-2507
Earth Science Data Operations Facility

Laboratory for Atmospheres — This laboratory performs a comprehensive theoretical and experimental research program dedicated to advancing our knowledge and understanding of the atmospheres of the Earth and other planets. The research program is aimed at advancing our understanding of the structure, dynamics, and radiative and chemical properties of the troposphere, stratosphere, and mesosphere, and thermosphere, determining the role of natural and anthropogenic trace species on the ozone balance in the stratosphere, and advancing our understanding of the physical properties of the atmospheres and ionospheres of the Earth and other planets.

Contact:
Franco Einaudi
(301) 286-5002

Tropical Rainfall Measuring Mission (TRMM) Office — The mission of this office is to develop a broad-based precipitation research and ground validation program including extensive studies in the theory and application of radar-rainfall estimation, for the Tropical Rainfall Measuring Mission (TRMM). This involves a number of validation sites representing a variety of rainfall regimes in the tropics that will meet both the pre-mission and the three-year mission flight phase science requirements.

Contact:
Otto Thiele
(301) 286-9006

Data Assimilation Office — This office uses general circulation models and advanced statistical methods to produce global meteorological data sets which are physically and chemically consistent. Research not only involves all aspects of the assimilation system, but also applications of the data sets to problems of global variability and atmospheric chemistry and transport. Future research will involve oceanic and land surface models.

Contact:
Richard Rood
(301) 286-8203

Satellite Data Utilization Office — Research in this office is oriented toward development of improved techniques to infer surface and atmospheric geophysical parameters from meteorological satellite observations for use in weather and climate studies. Major research areas use satellite data for initialization of general circulation models and in production of multiyear climate data sets to study climate variability and trends. In addition, simulation studies are performed on future instruments to assess their potential impact on weather and climate studies.

Contact:
Joel Susskind
(301) 286-7210

Mesoscale Dynamics and Precipitation Branch — This branch performs research on a broad range of meteorological problems ranging from convective cloud scale through synoptic scale to the global scale. The research emphasis is on the initiation, evolution, and impact on atmospheric precipitating systems and on the remote measurement of precipitation. Scientists in the branch employ theoretical and numerical modelling methods, observational analyses, and participate in sensor development for the measurement of precipitation. Specific topics include tropical and mid-latitude convective precipitation systems, fronts and gravity waves, tropical and extratropical cyclones, air-surface interactions, and global precipitation analysis.

Contact:
Robert Adler
(301) 286-9086

Climate and Radiation Branch — The primary function of the Branch is to conduct basic and applied research with the goal to improve fundamental understanding of regional and global climate on a wide range of spatial and temporal scales. Research emphasis is on physical processes involving atmospheric radiation and dynamics, in particular, processes leading to the formation of clouds and precipitation and their effects on the water and energy cycles of the Earth. Branch scientists adopt a variety of approaches to meet this goal.

Contact:
William Lau
(301) 286-7208

Planetary Atmospheres Branch — The Planetary Atmospheres Branch conducts theoretical and experimental research in the upper atmospheres and ionospheres of the Earth and other planets. Research in the atmospheres of the planets involves concentration on the physics and chemistry of their mesospheres, thermospheres, exospheres and ionospheres, and coupling between these regimes.

Contact:
Richard Hartle
(301) 286-8234

Atmospheric Experiment Branch — This Branch conducts experimental research in terrestrial, cometary and planetary atmospheres concerning chemical composition, atmospheric structure and dynamics. Scientists and engineers in the Branch participate in scientific investigations from experiment conception through flight hardware development, space flight and data analysis and interpretation. Instruments developed for space flight are primarily for the purpose of in situ measurement of atmospheric parameters.

Contact:
Hasso Niemann
(301) 286-8706

Atmospheric Chemistry and Dynamics Branch — This Branch is involved in research aimed at understanding the radiation-chemistry-dynamics interaction in the troposphere-stratosphere-mesosphere system. Scientists in the branch employ global-scale modeling; satellite measurements, especially of ozone; and the collection, analysis, and interpretation of global-scale data to aid in this atmospheric understanding.

Contact:
Mark Schoeberl
(301) 286-5819

Environmental Sensors Branch — Conceives of and develops advanced remote sensing techniques to measure chemical species and meteorological parameters of the earth's atmosphere. Conducts satellite, balloon, aircraft, and ground-based studies and experiments leading to improved observational techniques. Performs supporting theoretical and laboratory studies, and develops dependable calibration methods and procedures. Develops appropriate data analysis algorithms to convert observable data into useful geophysical results. Coordinates with other elements of the Laboratory for Atmospheres in conducting joint studies which demonstrate the utility of future remote sensing systems to regional and/or global scale studies of the atmosphere. Concentrates on the development of new and novel lidar systems by advancing the state-of-the-art of the systems to meet the needs of the atmospheric chemistry and meteorological communities.

Contact:
Harvey Melfi
(301) 286-7024

Laboratory for Terrestrial Physics — The Laboratory for Terrestrial Physics performs research directed at advancing the state of knowledge in the Earth sciences and the management of the resources of the Earth through the use of space technology.

These efforts include solid Earth geophysics, geology, space geodesy and the study of the biosphere.

Objectives are the complete, fruitful utilization of data of the Earth obtained from satellites and the development of future satellite systems that will enable deeper understanding of the Earth system. Activities include laboratory and field investigations, acquisition and use of data gathered aboard spacecraft and aircraft, and numerical simulation and modelling.

Applicants should discuss potential research programs with the appropriate point of contact below.

Contact:
David Smith
(301) 286-8671

Solid Earth Geophysics — Research topics include the structure and composition of the Earth's interior through geodetic studies of the gravity and magnetic fields, the study of the lithosphere through magnetic anomalies, the rotational parameters of the Earth and planets, the measurement of topography with altimeters and the study of planetary landforms.

Contact:
Herbert Frey
(301) 286-5450

Biospheric Studies — These include research on the interactions of electromagnetic radiation with plant canopies that permits the remote measurement of biomass and vigor and the study of phenomena such as deforestation and acid rain.

Contact:
Darrel Williams
(301) 286-8860

Experimental Instrumentation — Develops advanced electro-optic and laser sensors for ground-based, airborne and spaceborne Earth and planetary science applications. Work includes laser and detector research, sensor development research and conceptual design, performance calculations, sensor engineering and fabrication, as well as instrument calibration and integration. Sensors are used for measurements of Earth and planetary surfaces and of the Earth's atmosphere and oceans. Develops and manages advanced laser sensors, including laser altimeters and lidar systems, for airborne and spaceborne use.

Contact:
James Abshire
(301) 286-2611

Sensor Concepts and Calibration — Studies and analyses are directed toward development of optical remote sensing systems for observing reflected solar and emitted thermal radiation from the Earth/atmosphere system.

Research in advanced technologies enables new systems and research in techniques improves the precision of pre- and post-launch characterization/calibration. Research is directed at development of methods and methodologies to track the performance in orbit of sensors such as MODIS for EOS and the AVHRRs and NOAA. Unique tools for these studies include laboratory standards and a sensor which operates on the NASA ER-2 aircraft.

Contact:
B. Guenther
(301) 286-5205

Space Geodesy — Research uses precise geodetic methods, including laser ranging and very long baseline interferometry, altimetry, data from highly accurate tracking systems such as GPS and doppler, gradiometry and satellite-to-satellite tracking to measure and study the motion of the Earth on its axis, the kinematics of plate motion, the deformation of the crust, the Earth and ocean tides, and models of the gravity fields of the Earth and planets.

Contact:
John Bosworth
(301) 286-7052

Laboratory for Hydrospheric Process — The laboratory performs theoretical and experimental research on various components of the hydrological cycle and its role in the complete earth system. The program is aimed at observing, understanding, and modeling the global oceans and ice, surface hydrology, and mesoscale atmospheric processes. The laboratory conducts research on earth observational systems and techniques associated with remote and in-situ sensing.

Contact:
Antonio Busalacchi
(301) 286-6171

Oceans and Ice Branch — This branch conducts oceans and ice research to enhance understanding of these systems and their relationships with other elements of the biosphere and the geosphere. Works on problems in biological, physical, and polar oceanography; glaciology; and marginal ice zones and air-sea interactions. Pursues interdisciplinary studies, on problems such as those involving the biomass, productivity, nutrient distributions, carbon fluxes, geostrophic and

thermohaline circulation of tropical, mid-latitude, and polar oceans, and upwelling and ice sheets.

Contact:
Chester Koblinsky
(301) 286-4718

Observational Science Branch (Wallops Island, VA) — This branch conducts theoretical and experimental research on observational systems and techniques for oceanic remote sensing. Develops and operates research facilities (i.e., wave tank, laboratory field standards, aircraft remote sensors), ground-based ozone and wind sensors to obtain scientific data and develop new sensors.

Contact:
Dave Clem
(804) 824-1515

Hydrological Sciences Branch — The Hydrological Sciences Branch conducts research activities which contribute to an improved understanding of the exchange of water between the Earth's surface and its atmosphere. These research activities emphasize the use of remote sensing over a wide range of electromagnetic frequencies as a means of studying various hydrological processes and states, such as precipitation, evapotranspiration, soil moisture, snow and ice cover, and fluxes of moisture and energy. In addition, advanced numerical and analytical models are developed.

Contact:
E. Engman
(301) 286-5480

Microwave Sensors Branch — This branch performs research and development on advanced microwave sensing systems and data collection systems directed at providing remote and in situ data for research in the areas of the oceans, ecology, weather, climate, and hydrology. Performs basic theoretical , laboratory and field studies that elucidate the interaction of electromagnetic radiation with the environment to improve our understanding of remote sensing systems. Branch members contribute to the development of microwave science and engineering for the Tropical Rainfall Measurement Mission (TRMM), the Earth Observing System (EOS), and various airborne campaigns.

Contact:
James Weinmann
(301) 286-3175

SeaWiFS Project — The Sea-viewing Wide-Field-of-view Sensor (SeaWiFS), to be launched on Orbital Sciences Corporation's SeaStar satellite in September 1994, will provide global observations of ocean color for NASA. These data will be used to assess phytoplankton abundance, ocean productivity, and the ocean's role in the global carbon cycle. In addition, the observations will help visualize ocean dynamics and the relationships between ocean physics and large-scale patterns of productivity.

Contact:
Wayne Esaias
(301) 286-5465

Space Data and Computing Division — The Space Data and Computing Division (SDCD) enables NASA-supported scientists to increase their understanding of Earth and its environment, the Solar System, and the Universe through the computational use of space-borne observations and computer modeling. To help assure the research success of NASA- and Goddard Space Flight Center (GSFC)-related projects and programs, we are committed to providing the science community with access to state-of-the-art high performance computing, leading-edge mass storage technologies, advanced information systems, and the computational science expertise of a staff dedicated to supporting that community.

The SDCD manages and operates the NASA Center for Computational Sciences (NCCS), a primary supercomputing and data storage center for support of NASA missions and programs, and, on a national basis, for approved programs of the external NASA and university communities. The SDCD utilizes state-of-the-art computational equipment and data systems to provide end-to-end support of computational research conducted by the Earth and Space Sciences Directorates at GSFC and to a somewhat lesser extent external NASA approved research investigators. Specifically, the SDCD meets its science-driven requirements by providing specialized computational processing and archival services for approved projects and individual scientists as well. In addition, the SDCD provides support in the areas of sensor algorithms for direct ground communications readout of satellite transmissions, information processing, discipline data base management systems, high performance computing and parallel processing, high speed local and wide area network support, and advanced science data visualizations systems.

The NCCS engages in the application of advanced computer system architectures, such as the CRAY C-98, and massively parallel machines such as the MASPAR MP-2, to support complex computational physics modeling efforts. These modeling efforts involve, for example, studies of coupled multi-dimensional ocean and atmospheric systems, multi-dimensional magnetospheric-ionospheric systems, and astrophysical processes. Specific research opportunities exist for development of new numerical algorithms in computational physics that utilize advanced computer architectures, development of advanced scientific visualization, algorithms for visualization of space and Earth science processes, and the development of advanced techniques for managing decaterabyte mass data storage and delivery systems.

Contact:
Jan M. Hollis
(301) 286-7591

Goddard Institute for Space Studies (New York, NY) — The Institute for Space Studies conducts comprehensive theoretical and experimental research programs in four major areas.

Causes of Long-Term Climate Change — Basic research on the nature of climate change and climatic processes, including the development of numerical climate models. Primary emphasis is on decadal or end-of-century global-scale simulations, including studies of humanity's potential impact on the climate. Climate sensitivity and mechanisms of climatic change are investigated in global paleoclimatic research, specifically from the comparison of pollen and glacial data with paleoclimatic model simulations. In addition to their use for climate simulations, the global models are used to simulate the transport of atmospheric constituents and thus study their global geochemical cycles. The program also includes development of techniques to infer global cloud, aerosol and surface properties from satellite-radiance measurements as part of the International Satellite Cloud Climatology Project and the Earth Observing system and analysis of the role of clouds in climate.

Contact:
Anthony Del Genio
(212) 678-5588
Convection and Clouds

James Hansen
(212) 678-5619
Greenhouse Effect

Dorothy Peteet
(212) 678-5593
Paleoclimate, Pollen Studies

David Rind
(212) 578-5593
Climate Dynamics, Stratosphere

William Rossow
(212) 678-5567
Global Cloud Properties

Andrew Lacis
(212) 678-5595
Radiative Processes

Planetary Atmospheres — Concerned with investigations of Jupiter, Saturn, Venus, and the Earth. The observational phase of the program includes imaging and polarization measurements from the Pioneer Venus Orbiter and radiation-budget, temperature-sounding, photometric, and polarization measurements from the Galileo Jupiter Orbiter. The theoretical phase of the program includes interpretation of radiation measurements of planets to deduce bulk atmospheric composition and the nature and distribution of clouds and aerosols, and analytical models. Emphasis in the theoretical program is on analysis of physical processes in terms of general principles and models applicable to all planets.

Contact:
Michael Allison
(212) 678-5554

Anthony Del Genio
(212) 678-5538
Atmospheric Dynamics

Larry Travis
(212) 678-5599

Barbara Carlson
(212) 678-5538
Radiative Transfer

Biogeochemical Cycles — Research on global biogeochemical cycles involving the study of chemically and radiatively important trace gases. The aim is to improve our understanding of the cycles of CO_2, CH_4, N_2O, CFCs, O_3, NOX, OH, and other trace compounds which are expected to affect climate and air quality in the near future. The research involves three-dimensional chemical tracer models, which are essential for determining the sources and sinks of these gases and for predicting future atmospheric composition. Central to the program is the investigation of the role of the biosphere, terrestrial and oceanic, in the global carbon cycle using a combination of satellite measurements and modeling.

Contact:
Inez Fung
(212) 678-5590
Carbon Cycle, Ocean Modeling

Interdisciplinary Research — Interdisciplinary research ranges from theoretical studies of the origin of the solar system to relationships between the Sun, terrestrial climate, geological processes, and biology. One phase of the program involves the structure and evolution of accretion disks, especially the primitive solar nebula, using models of large-scale turbulence. Another topic is the calculation of molecular properties of atmospheric and astrophysical interest. A third area concerns the evolution and pulsation of bright stars. which may be analogs of the Sun. A biological question of special interest concerns how terrestrial vegetation will change during the next 50 years, when climate and atmospheric CO_2 are expected to be changing.

Contact:
Vittorio Canuto
(212) 678-5571

Sheldon Green
(212) 678-5562
Molecular Calculations

Richard Stothers
(212) 678-5605
Stars, Climate Studies

Dorothy Peteet
(212) 678-5587
Biology

Engineering Directorate

The Engineering Directorate supports NASA Space and Earth Sciences and application programs through technical research and development. The Directorates enabling technology program increases knowledge and capabilities in areas necessary for the success of assigned NASA missions. The design, development and test of components, subsystems, instruments and spacecraft for multiple programs and projects is an important part of the mission of the Engineering Directorate. The Engineering Directorate oversees the in-house development of flight hardware and software including instruments, Attached Shuttle Payloads, and Small Explorer Spacecraft, and provides system and discipline engineering support for space and Earth Science missions such as the Hubble Space Telescope and Earth Observing System.

Contact:
Henry Plotkin
(301) 286-6185

Thermal Development Laboratory — This laboratory is responsible for the development of new thermal control technology for future NASA spacecraft. Current work efforts focus on such technologies as cryogenic heat pipes, two-phase capillary pumped loops, and heat pumps. The scope of the work encompasses concept development, breadboard to prototype testing, conduction of flight experiments, and analysis. The 7000 square foot laboratory/office area has numerous test loops. These range in size from small benchtop units to an 8 ft. by 30 ft. facility, which is the largest known modular two-phase test bed. A wide variety of instrumentation, data collection/processing, and other support equipment are available to support these testing efforts.

Contact:
Theodore Swanson
(301) 286-6952

Optics Laboratory — The Optics Branch conducts research and development programs in the optical sciences and engineering to support flight experiment development in the areas of high energy astrophysics, solar and stellar astronomy, atmospheric sciences, and ocean and terrestrial sciences. Specific research and development objectives include optical property characterization of solids and thin films, diffraction grating technology, optical system design and analysis, and advanced optical fabrication and testing. Modern laboratory facilities are equipped for optical property studies in the far-infrared to the extreme ultraviolet, generation of holographic diffraction gratings, and optical fabrication and testing. In addition, extensive computer facilities are available to support optical design and analysis studies.

Contact:
John Osantowski
(301) 286-3873

Electromechanical Branch — Develops mechanical, optomechanical, and electromechanical systems required to support flight instrument and spacecraft projects. Conducts advanced and supporting research and development efforts to support new technology, such as magnetic bearings and cryogenic mechanisms, applicable to existing and future spaceflight requirements. Deployable appendages such as magnetometer booms and 100 meter long electric field antennas are developed. Flight structures ranging in size from small optical benches to instruments weighing several tons are provided. Electromechanical systems and their control electronics are developed, taking into account the effect of spacecraft structural disturbances (jit

ter) where applicable. Modern laboratory facilities are equipped for electromechanical fabrication and testing.

Contact:
Mike Hagopian
(301) 286-7854

Willie Blanco
(301) 286-3964

Cryogenics Laboratory — This laboratory conducts research and development programs in low temperature physics in support of astrophysics goals. General research objectives are the development of low temperature microcalorimeters for the detection and imaging of charged particles and radiation, and high-precision and high-accuracy thermometry. Current research focuses on detectors and sensors using thin-film superconductors. This includes the development of detectors using tunnel junctions to obtain energy and/or spatial resolution, kinetic inductance calorimeters, and thermometry using superconductors. Modern laboratory facilities are equipped for detector characterization, including cryogenic workstations with automated data collection, SQUID systems, dilution and adiabatic demagnetization refrigerators, and facilities for evaporation and sputtering of thin films.

Contact:
Stephen Castles
(301) 286-5405

Photonics & Automated Systems Branch — This Branch conducts a broad program of applied research in optics, electro-optics and autonomous systems, including high power semiconductor lasers, diode-pumped solid state lasers, passive focal plane sensor systems used for remote sensing applications and telerobotic systems. A major thrust exists in the investigation of the use of laser diodes as the transmitter source for active remote sensing instruments. Both the physics and engineering aspects of these systems are under investigation.

Instrumentation is being developed for ground-based and flight observational research from ultraviolet to far-infrared wavelengths. Technologies under development include acousto-optic tunable filters, cryogenic cameras, interferometers and spectrometers. The Branch also supports the development of automated systems for GSFC managed programs and servicing missions.

Contact:
John Wolfgang
(301) 286-2219
Photonics Branch

Mechanical Engineering Branch — The Mechanical Engineering Branch performs structural and mechanical design for in-house STS and ELV launched spacecraft, instruments, and mechanical ground support equipment. These designs include spacecraft and instrument primary and secondary structures; deployable appendages such as solar arrays and antennas; flight mechanisms such as actuators, hinges and release mechanisms; and mechanical ground support equipment such as lift slings, dollies, containers, and g-negation hardware. The Branch also provides support for fabrication, assembly, integration, and testing of spacecraft and instrument structures including structural design research and design optimization of advanced composite materials. The Branch performs structural analyses in support of flight hardware design and testing and provides advanced development for maintaining state-of-the-art CAD/CAM technology.

Contact:
R. Ken Hinkle
(301) 286-6003

James Woods
(301) 286-2251

Gary Jones
(301) 286-5837
Structural and Mechanical Design and Analysis

Mission Operations and Data Systems Directorate

The Mission Operations and Data Systems Directorate is responsible for the following: (1) planning, design, development, and operation of spaceflight tracking and communications networks and data systems support of near-earth spaceflight missions; (2) activities in mission planning, mission analysis, space and ground network operations, spacecraft and payload command and control, flight dynamics, information processing, and flight mission operations; (3) planning and applied research development of advanced data systems and telecommunications systems in support of spaceflight missions; and (4) ensuring that space and ground communications network, mission analysis and support computing capabilities, and end-to-end data systems meet mission support requirements and are maintained at the state of the art.

Contact:
Donald Wilson
(301) 286-7550
New Technology and Data Standards Manager

Data Systems Technology Division — The Data Systems Technology Division develops and applies systems, hardware, and software technologies to support complex command and control, communications, and telemetry data processing requirements of future space missions. The division performs advanced technology development in high performance VLSI systems for telemetry processing, high data rate/volume data storage architectures, distributed systems and networks, computer-aided software engineering, human-machine interface technology, and artificial intelligence-primarily in the areas of knowledge-based, model-based, and agent-based systems; planning and scheduling; and monitoring and control. Joint projects are formed with other Goddard organizations to transfer technology from the laboratory into operational systems through the development of test beds and advanced operational prototypes. Application projects include VLSI-based telemetry front end processors and workstations, a test bed for distributed mission planning and scheduling, a computer-aided systems engineering support environment, an advanced user interface design and development environment (TAE Plus), an agent technology test bed, and a prototype sel-organizing network for distributed telemetry systems. Division laboratory facilities provide some of the most advanced systems design and development capabilities available, including a complete suite of VLSI design tools, libraries, and workstations; advanced commercial parallel disk farms; VME components for system integration; workstations from SUN, HP, DEC, IBM, Silicon Graphics, and NEXT; advanced tools for systems and software engineering, modeling, and human-computer interface design; and expert systems shells and development environments.

Contact:
Toby Bennett
(301) 286-5406
VLSI systems

Sylvia Sheppard
(301) 286-5049
Human-Machine Interfaces
Computer Aided Systems Engineering

Jay Costenbader
(301) 286-5292
Planning and Scheduling

Walt Truszkowski
(301) 286-8821
Artificial Intelligence

Flight Dynamics Division — Research is conducted toward the development of algorithms and techniques to support flight dynamics mission requirements. Areas of particular interest are spacecraft orbit and attitude dynamics modeling and the development of dynamics simulators, planning of launch and maneuver parameters to tailor spacecraft trajectories for specific missions, analysis and evaluation of advanced sensor and actuator hardware including the characterization of error sources, and development of efficient and robust algorithms for the estimation of spacecraft attitude and orbit parameters. This research depends on contributions from astrodynamics, linear and nonlinear estimation theory, system identification, linear and nonlinear dynamic system analysis, and applied mathematics.

Major experiments are currently active or planned in the following disciplines:

- Ada, as a development language and overall design discipline
- Reusable software concepts and approaches
- Structured methodologies such as the "Clean Room" approach
- Software development environments
- Software maintenance tools and techniques

Research in the systems engineering disciplines includes:

- Development of advanced graphics techniques for flight dynamics problems
- Application of expert system technology to flight dynamics.

Contact:
Rose Pajerski
(301) 286-3010

Jet Propulsion Laboratory

Program Administrators:

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The primary role of the Jet Propulsion Laboratory (JPL) within the NASA family is the exploration of the solar system, including planet Earth, by means of unmanned, autonomous spacecraft, and instruments.

In addition, an active community of JPL scientists, technologists, and engineers is engaged in Earth atmosphere and geosciences, oceanography, planetary (including asteroid and comet) studies, and solar, interplanetary, interstellar, and astrophysical disciplines. Opportunities for Graduate Student Researchers exist in all technical divisions of JPL. These technical divisions, organized by general discipline area, encompass almost all JPL engineering and science resources. Each technical division is concerned with the planning, design, development, engineering, and implementation functions relevant to its discipline area. Fundamental to the structure of JPL is the cooperation among the research, science and advanced technology and the engineering functions of these operating divisions.

Systems Division

The Systems Division performs systems engineering and design integration for all the major projects undertaken by JPL. It also conducts specialized analyses in many disciplines to support these projects.

Contact:
Kent Frewing
(818) 354-6780

Mission Design — Includes interplanetary spacecraft trajectory design, planning mission timelines to accommodate science requirements, launch vehicle trajectory analysis, studies of advanced interplanetary scientific missions, and software development to support mission design and analysis.

Spacecraft Systems Engineering — Supports JPL flight projects by providing design integration of the total spacecraft system, including its interfaces with the launch vehicle and with its scientific instrument payload. It also conducts studies and analyses of advanced future spacecraft designs and analyzes the performance of spacecraft in flight.

Navigation Systems — Develops the capability to determine very precisely the position and velocity of scientific spacecraft in interplanetary space through radiometric and optical techniques, designs propulsive maneuvers to place spacecraft on correct trajectories, develops complex software to solve the equations of motion, and conducts scientific studies of relativistic gravity, planetary orbital dynamics gravitational radiation and planetary masses and gravity fields using spacecraft radio tracking data.

Mission Profile and Sequencing — Develops the detailed sequences to be executed by interplanetary spacecraft, plans the commands required to carry out the sequences, and develops the software that keeps track of the command sequences and ensures the commands will safely perform the desired functions. Provides support to science activity development and implementation. Conducts research related to planning and sequencing software technology.

Project Test and Operations — Performs planning, management and performance of test, integration and launch activities for major systems, including spacecraft, science instruments, ground data systems and ground support equipment. Conducts research and development for integration and test technologies and operates and manages JPL's major Spacecraft Assembly Facility.

Mission Information Systems Engineering — Supports JPL flight projects in the development of plans for the operation of interplanetary spacecraft in flight. This involves design of the end-to-end data system from the spacecraft instrument to the scientist receiving the data, as well as design of ground-based systems of hardware, software, and teams used to control the spacecraft and process the data.

Systems Analysis — Performs economics, operations research, costing, and mission analyses for a broad spectrum of unmanned and manned space projects and military and civilian ground-based programs.

Technology and Applications Systems Engineering — Performs system level design, integration, and development of information systems, including computer hardware and software and large distributed near real time ground data processing. Disciplines include traditional electrical, mechanical, aeronautical, and aerospace engineering, along with computer science, operations research, economics, and the physical sciences.

Earth and Space Sciences Division

The division conducts a wide-ranging program of research in oceanography, the atmospheres and solid bodies of Earth and other planets, planetary satellites, asteroids, comets, interplanetary medium, and selected solar, stellar, and interstallar phenomena. Ground-based observations, aircraft, balloons, and Earth-orbiting and planetary spacecraft are utilized. Extensive laboratory and theoretical research efforts, data analysis, interpretation, and modeling support these observational programs.

Contact:
Clifford Heindl
(818) 354-4603

Oceanography — Altimetry for determining currents and tides; air-sea interactions including, fluxes of mass, momentum, energy, and chemicals between ocean and atmosphere; determination of marine biomass and ocean productivity; sea ice dynamics and influence on climate variability; global surface temperature measurements; surface driving forces and wave propagation derived from radar observations.

Contact:
Donald Collins
(818) 354-3473

Earth Atmosphere — Laboratory research, field measurements, and data analysis to understand the chemistry of stratospheric ozone; monitoring of long-term trends in important minor and trace constituents; extraction of meteorological parameters from satellite data, including temperature profiles, humidity, clouds, winds, and pressure.

Contact:
James Margitan
(818) 354-2170

Planetary Atmospheres — Observations from ground-based telescopes and analysis of spacecraft data to determine composition, structure, and dynamics; long-term study of seasonal and interannual variability; global mapping; synthesis of information to determine physical processes and state of the atmospheres.

Contact:
Jay Goguen
(818) 354-8748

Earth Geoscience — Characterization of exposed rocks, sediments, and soils on the Earth's surface to understand the evolution of the continents; examine state and dynamics of biological land cover for assessment of the role of biota in global processes; tectonic plate motion; volcanology; paleoclimatology.

Contact:
Diane Evans
(818) 354-2418

Planetology — Observations of the surface of the inner planets, satellites and rings of the outer planets, asteroids and comets across the spectral range from ultraviolet through active and passive microwave; studies of meteorites and cosmic dust; theory and modeling relevant to the origin and evolution of the solid bodies of the solar system; development of approaches to the detection and characterization of solar systems around other stars.

Contact:
Charles Yoder
(818) 354-2444

Space Physics — Mapping of the magnetic fields of the Sun and planets and their time variations; structure and dynamics of the solar wind; and interactions of solar fields and particles with the magnetic fields and outer atmospheres of Earth and planets.

Contact:
Marcia Neugebauer
(818) 354-2005

Astrophysics — Variability of the solar constant; sky survey of infrared sources; composition and chemistry of interstellar clouds; identification of gamma-ray sources within the galaxy and beyond; observations of supernova 1987A; studies of gravitational wave detection utilizing spacecraft.

Contact:
James Ling
(818) 354-2819

Telecommunications Science and Engineering Division

Astrophysics — Observational and theoretical research into the nature of radio emissions from quasars, galaxies, and stars.

Contact:
Robert Preston
(818) 354-6895

Gravitational Wave Studies — Algorithm development and data analysis of spacecraft tracking data for the detection of very low-frequency gravitational waves predicted by general relativity and other theories of gravity.

Contact:
John Armstrong
(818) 354-3151

Planetary Atmospheres and Interplanetary Media — Experimental and theoretical research investigations based on the use of spacecraft radio signals to probe planetary atmospheres and the interplanetary/solar plasma.

Contact:
Richard Woo
(818) 354-3945

Planetary Dynamics — Determination of orbital, rotational, or atmospheric motions of planets by tracking of spacecraft or balloons associated with the planets.

Contact:
Robert Preston
(818) 354-6895

Asteroid Dynamics — Study orbital evolution of main belt and planet crossing asteroids, resonances, and asteroid families.

Contact:
James Williams
(818) 354-6466

Geodynamics — Experimental and theoretical investigations of global and regional phenomena using the modern space geodetic techniques of lunar laser ranging, Very Long Baseline Interferometry (VLBI) and the Global Positioning System (GPS).

Contact:
Jean Dickey
(818) 354-3235

Information Theory and Coding — Theoretical research into information theory, channel and source codings with special emphasis on very noisy channels and some interest in fading and band-limited channels.

Contact:
Laif Swanson
(818) 354-2757

Optical Communication — Theoretical and experimental research involving free space laser communications systems, components, and techniques, and including such items as lasers, detectors, modulators, signal design, large telescope design, spatial and temporal acquisition and tracking, detection strategies, and channel coding.

Contact:
James Lesh
(818) 354-2766

Frequency Standards Research — Experimental investigations including ultra-high resolution spectroscopy to support development of stable sources of microwave and optical frequencies.

Contact:
Lute Maleki
(818) 354-3688

Planetary Radar Astronomy — Experimental and theoretical research in planetary surfaces, atmospheres, and rings (including geology, spin dynamics, and scattering properties of rings and cometary debris swarms) using the ground-based Goldstone radar system, the very large array, and Arecibo Observatory to form images of terrestrial planets, asteroids, and comets.

Contact:
Martin Slade
(818) 354-2765

Radar Remote Sensing of the Earth — Experimental and theoretical investigations in remote observation of the Earth's surface through radar scattering properties, for example, polarization and interferometry to determine the structure and motion of regions of interest.

Contact:
Howard Zebker
(818) 354-8780

Avionic Systems and Technology Division

Control Systems — Development of electronics, actuators and sensors to enable precision control of space systems. Development of modeling and simulation tools, computational procedures and architectures for design and analysis of electromechanical control systems.

Contact:
Guy K. Man
(818) 354-7142

Autonomous Control and Tracking Systems — System architectures, sensors, and actuators for autonomous rendezvous, docking, aerobraking, and landing. Development of concepts to enable high bandwidth control of flexible space structures and to provide active space control. Advanced control systems and algorithm development for target tracking.

Contact:
George Sevaston
(818) 354-0395

Electro-optical Tracking Systems — Development and testing of electro-optical sensors and algorithms for star, limb, and target-feature tracking. Development of interferometric metrology sensors and systems.

Contact:
Randy Bartman
(818) 354-5320

Power Research and Engineering — Development of lightweight, high-power fuel cells; high efficiency thermal-to-electric conversion for space nuclear power; high energy batteries; power electronics and automated power systems management.

Contact:
Perry Bankston
(818) 354-6793

Flight Computers — Development of computer technology for flight application, including advanced microelectronic and fault-tolerant architectures, multi-chip modules, ultra-low power VLSI, radiation tolerance, high speed optical computing and networking.

Contact:
Leon Alkalaj
(818) 354-5988

Microelectronic Device Research — A wide variety of research is being pursued using the new Microdevices Laboratory: submillimeter and infrared radiation detectors, electron tunneling microscopy, quantum will structures, molecular beam epitaxy, chemical vapor deposition, E-beam lithography, transmission electron microscopy, etc.

Contact:
Barbara Wilson
(818) 354-2969

Autonomous Mobile Vehicle — Real-time path planning in uncertain terrains; wheeled locomotion and mobility, image processing for rover control, and combined mobility and manipulation.

Contact:
Brian Wilcox
(818) 354-4625

Robot Arm Control — Research in advanced modeling, adaptive control, hierarchical control software architectures, complex task simulation, etc., as they pertain to redundant dual-arm manipulation systems.

Contact:
Homayoun Seraji
(818) 354-4839

Advanced Teleoperation and Man-Machine Systems — Man-machine interfaces for advanced teleoperation and supervisory automation, including the development of electro-mechanical, graphics, and computing architectures. Also, human-factors-based experiments and data analysis.

Contact:
Paul Schenker
(818) 354-2681

Data Storage Technology — Investigation of semiconductor and magnetic materials for the development of data storage technology for space, including advanced technology such as Vertical Bloch Lines (VBL).

Contact:
Romney Katti
(818) 354-3054

Mechanical Systems Division

The Mechanical Systems Division carries out research in propulsion, cryogenics, structures, materials, and thermal sciences. Research opportunities exist in polymeric materials with unique electronic and optical properties, use of active members to control vibrations and for shape control of precision structures, cryogenic cooling systems, including sorption refrigeration, adaptation of Stirling cycle coolers to space instruments, and advanced superfluid helium cryostats, electric propulsion and autonomous mobility, and sample acquisition.

Contact:
Donald Rapp
(818) 354-4931

Information Systems Development and Operations Division

The Information Systems Development and Operations Division performs research, development, planning, and operations related to ground-based information systems for spacecraft missions and other tasks in the national interest. Activities include: (1) data acquisition, (2) radiometrics and radio science, (3) telemetry, (4) monitoring and control, (5) command, (6) data management, (7) non-imaging science data handling, (8) data product generation, (9) institutional computing (and supercomputing), communication, and computer networking services, and (10) institutional and microprocessor software applications.

Research areas include: (1) advanced automation for spacecraft diagnosis and ground system operations, (2) simulation and graphics for knowledge fusion, data understanding, and training, (3) high-rate, high-capacity information systems, (4) software productivity and reliability, (5) intelligent access to large, interactive hypermedia databases, (6) high-performance computing and networking, (7) numerical analysis and computational software libraries, and (8) low-cost mission operations.

Contact:
Robert Tausworthe
(818) 306-6284

Observational Systems Division

The Observational Systems Division is responsible for the conception, design, engineering development, and implementation of a variety of scientific instrumentation for space flight applications. A key element in the division is digital image processing research and development for space science and environmental and Earth resources applications.

Contact:
Robert Beale
(818) 354-7584

Imaging Systems — Design, development, and implementation of imaging and spectrographic systems for use in space science investigations. Developed imaging systems for Voyager, Galileo, and Hubble Space Telescope missions. Currently developing imaging systems for the Cassini Mission, and the Multiangle Imaging Spectroradiometer for the Earth Observing Mission. In addition to end-to-end engineering of flight instruments, the section is at the forefront in research and advanced development for solid state imaging array detectors and on focal plane electronics for X-ray, ultraviolet, visible, and shortwave infrared detection. These advanced scientific imaging detectors will support development of the next generation of spaceborne imaging systems, as well as being introduced into commercial products.

Contact:
Christopher Stevens
(818) 354-5545

Infrared and Analytical Instrument Systems — Conception, design, advanced development, and implementation of scientific instrumentation for remote sensing in the infrared and in situ analyses of chemical species using mass spectrometry and scanning electron microscopy. Missions addressed include planetary exploration, Earth remote sensing, and astrophysics. This section is particularly active in the development of

imaging spectrometry for a wide variety of applications. This is a measurement technique in which materials may be identified through their unique spectral signatures. The section is also active in the development of enabling technology, particularly IR Focal Plane Arrays and related components.

Contact:
Mark Herring
(818) 354-6817

Microwave Observational Systems — Conceive, design, implement, and calibrate scientific radiometer systems in the microwave through submillimeter wavelength regions. This includes advanced research and technology development of submillimeter wave components and advanced spectrometers to support near term and future remote sensing missions. They develop opportunities for new microwave instrument systems with the user community. They also develop theoretical models describing the interaction between microwave signals and the atmospheric and surface parameters.

Contact:
Gary Parks
(818) 354-8053

Image Processing Applications and Development — Develops and applies image processing techniques to the display, analysis, and interpretation of image and image-related data. Utilizing engineering and artificial intelligence to develop automated and semi-automated schemes for data interpretation. Performs research and development in image processing. Also develops and applies specialized software, hardware, and systems architectures to increase the speed of computationally intensive functions on large data sets. Provides image processing and analysis support to the flight projects, imaging teams, and the science community.

Contact:
Ray Wall
(818) 354-5016

Optical Sciences and Applications — Basic and applied research in advanced optics technologies. Uses unique computational tools for optical design and system analysis to support development of various remote sensing systems for astrophysics and Earth and interplanetary scientific measurements. Large mirror advanced optical materials, adaptive optics, thermal infrared optics, ultra-low scattered light optics, electro-optics, hyperspeed image correlators, and sensor systems for the Long-Baseline Michelson Stellar Interferometer are examples of study areas. Development of advanced space flight hardware optical systems for use in the visible, infrared, ultraviolet, and submillimeter spectral regions for science applications take place in this section.

Contact:
James Breckinridge
(818) 354-6785

Earth Observations Analysis Systems — Design, develop, validate, and operate data systems for Earth and astrophysical observing systems. Provide algorithms and models both of the instruments and the observed phenomena necessary to extract meaningful geophysical and astrophysical information from these observations. Use state-of-the-art parallel computational systems to implement these algorithms. Areas of active work include plasma physics, atmospheric modeling, modeling of electromagnetic scattering of microwaves, and radiative transfer in the atmosphere. Field experiments are also performed.

Contact:
Jack Fanselow
(818) 354-6323

Science Data Systems — Design, develop, and operate science data processing systems and science data archiving systems for NASA and non-NASA missions. In addition, build text-based archival and retrieval systems using tools such as Mosaic. Develop reusable tools and standards in all areas of archiving and processing to leverage efficiency in operation. Lead in research and development of archive products and distribution technologies such as CD-ROMs and network access to products.

Contact:
Tom Renfrow
(818) 306-6044

Hardware Assurance

Microelectronic Radiation Hardness Assuracnce — Work is focused on research and testing of the reliability of electronic parts in the harsh radiation environments experienced by NASA spacecraft. Current activities include investigations into radiation effects in electronics and photonics caused by heavy ions characteristic of galactic cosmic rays, electrons, protons and ^{60}Co gamma rays; simulation of single event effects (SEE) by ^{252}Cf; and radiation testing of parts for NASA flight projects. In addition, evaluations are performed of test methodologies and process technologies used to produce reliable, radiation-tolerant microelectronic circuits such as application specific integrated circuits (ASICs), field programmable gate arrays (FPGAs) and large memories (SRAMs, DRAMs).

Contact:
Charles Barnes
(818) 354-4467

Systems Assurance

This division conducts research in a wide range of areas concerned with the quality and reliability of spacecraft systems. Research opportunities exist in the modeling, analysis, and simulation of the natural and induced spacecraft mission environments and of their effects on spacecraft systems, subsystems, and individual components. Software reliability analyses and metrics definition are other areas of rapidly growing research. Specific issues associated with software, spacecraft sensors, control systems, and other flight hardware are of interest.

Contact:
A.G. Brejcha
(818) 354-3080

Reliability Engineering — Develops reliability and environmental design, analysis, and test requirements for all JPL flight projects. Reliability activities include electrical and mechanical analyses and environmental requirements activities include: thermal, dynamics, electromagnetic compatibility, and natural space environments. Natural environments include solar and planetary thermal conditions, micrometeoroids and space debris, and space plasma. Induced environments include vibration, acoustic, pyrotechnic shock, and thermal loads, electromagnetic effects, spacecraft charging, etc.

Contact:
T.E. Gindorf
(818) 354-4451

Software Product Assurance — Software Product Assurance has the objective to help ensure the operational integrity of the software developed for JPL systems, and evaluates the operational requirements, the acceptability and readiness of all software prior to delivery. It also researches advanced techniques in software engineering, human computer interface, software safety, and metrics, and performs technology transfer to techniques tailored for the JPL and NASA environment to improve the quality of software within JPL and NASA.

Contact:
R. Santiago
(818) 354-2452

Multimission Operations Systems Office (MOSO)

The Multimission Operations Systems Office integrates the development of hardware and software tools to provide efficient and effective multimission operations systems and services to JPL's planetary science projects in order to minimize the cost of mission operations and data analysis. These systems and services include spacecraft analysis and navigation, mission planning and sequencing, science analysis, mission control and data management, computers and communications, and telemetry.

Contact:
Steve Huffman
(818) 354-6068

Chief Engineer — Provides top-level problem identification, isolation, and correction activity. Activities currently include data system security, space flight operations facility security, and data systems standards.

Contact:
Bob Polansky
(818) 354-4940

Program Control and Administration (PC&A) — Integrates the resources planning, scheduling, statusing, and reporting functions to provide costs and schedule control tools for management. Office utilization and automation, personnel administration, network administration, and inventory control are also integral parts of the PC&A function. Client/server architecture and LAN technology serves as the backbone for communications between the PC&A functions and all levels of management.

Contact:
Kirk Gerbracht
(818) 354-3107

Advanced Systems — Focuses on the development and utilization of advanced technology for mission operations and data analysis with the primary goal of increased productivity at lower cost.

Contact:
Barbara Anderson
(818) 354-0896

Flight Projects Interface — Provides the focus for interactions between the Multimission Operations Systems Office (MOSO) and various flight projects, assuring proper understanding and documentation of flight project requirements and the Flight Support Office commitments to the projects.

Contact:
Al Beers
(818) 354-3416

System Integration and Verification — Manages system integration and test, configuration management, system administration and hardware quality assurance activities. System Integration and Test activities integrate qualified software subsystems into an executable system configuration and demonstrate performance against contractual and approved user requirements. Configuration management services include configuration identification, configuration control, configuration audits and status accounting. Configuration Management implements, controls and measures engineering processes used to support the flight projects.

System Administration includes the activities required to maintain the Multimission Ground Data System (MGDS) environment in the operational configuration. System Administration monitors and manages the network configuration and implements security procedures to prevent unauthorized access to the system. Hardware Quality Assurance consists of the system, procedures, and activities for assuring that an item will perform satisfactorily in actual operation by verifying that materials, construction, and testing meet the requirements of project and procurement specifications.

Contact:
Andy Dowen
(818) 354-8191

Flight Support Facilities — Maintains critical Space Flight Operations Facility resources such as emergency power, communications capabilities, and Deep Space Network interface. Controls the facility configuration during critical mission phases such as launch and encounter. Evaluates space requirements for flight project's Mission Support areas and plans facility modifications as required.

Contact:
Jim Allen
(818) 393-7880

Lyndon B. Johnson Space Center

Program Administrator:

Nancy G. Robertson
Chief, Education Branch
Mail Code AP2
NASA Lyndon B. Johnson
Space Center
Houston, TX 77058
(713) 483-2462

The Johnson Space Center is involved in a wide range of activities dealing with manned space flight and space exploration. The majority of research areas available for Graduate Student Researchers are in engineering and development and space and life sciences. Additional information concerning the following opportunities may be obtained from the program administrator.

Engineering

Life Support Systems — The research area includes: 1) study of advanced physiochemical and biological life support technologies for air revitalization, water reclamation, food production and solid waste management; 2) development of mathematical models for the candidate life support systems for future Moon and Mars missions; and 3) development of automatic control and monitoring techniques at the system level to minimize crew time/effort required for operation of a regenerative life support system.

Contact:
Chin Lin
(713) 483-9126

Advanced Life Support Systems — Current research involves development of regenerative human life support systems for future long-duration space missions. Such systems will consist of components which utilize both physicochemical and biological processes to perform the life support functions. Included in these functions are air revitalization, which includes carbon dioxide removal and reduction, oxygen generation, and trace gas contamination control. Water recovery functions include urine treatment, hygiene water processing, and potable water polishing. Food production functions involve crop production using both hydroponic and solid substrate culturing systems. Resource recovery from solid wastes involves such processes as incineration, pyrolysis, and supercritical oxidation. Additionally, integration of these systems into a functioning regenerative life support system via highly automated control and monitoring systems is critical to current development efforts. Research opportunities exist for students specializing in chemistry, physics, horticulture and plant physiology, soil science, water chemistry, and environmental, chemical, biological, mechanical, computer, and system engineering disciplines.

Contact:
D. L. Henninger
(713) 483-5034

Spacecraft Thermal Management Systems — The research area includes: 1) light weight, high efficiency heat pumps and unique heat rejection devices to aid in room temperature heat rejection of advanced missions; 2) high heat flux evaporators and condensers and two-phase flow measurement devices; 3) theoretical studies and analysis techniques for advanced thermal management systems; and 4) automated monitor, control, and fault detection methods for large two-phase heat transport systems.

Contact:
E. K. Ungar
(713) 483-9115

Advanced Extravehicular (EVA) Systems — The research area includes EVA gloves and advanced thermal protective systems for astronaut space suits, regenerable portable life support subsystems, associated airlock support systems, and equipment that will enhance EVA safety and productivity.

Contact:
M. N. Rouen
(713) 483-9242

Tracking and Communications — Research opportunities exist in expert systems for control and monitoring of complex C&T systems; optical and RF sensor systems for autonomous rendezvous and landing operations; efficient multi-access secure systems; programmable digital transmit/receive systems; MMIC distributed array antennas; multi-beam and high-gain electronically steerable antennas; conformal arrays; infrared and optical/laser communications systems; voice recognition systems for control; digital and optical transformation/correlation systems; end-to-end systems analytical/simulation models of C&T systems; space-to-ground HDTV; and orbital debris detection and tracking.

Contact:
William E. Teasdale
(713) 483-0126

Guidance, Navigation, and Control — Research opportunities exist for definition/development of guidance, navigation, and control systems for space flight programs. These systems include GN&C software algorithms, navigation sensor hardware, flight control sensor and effector hardware. An advanced technical base is maintained involving test and laboratory facilities and computer simulations to analyze, demonstrate, and test new techniques and concepts. Research opportunities also exist in flight dynamics, aerodynamics/aerothermodynamics, and computational fluid dynamics.

Contact:
Aldo J. Bordano
(713) 483-8177

Flight Data Systems — Research opportunities exist for conducting research and system engineering assessments of advanced manned mission data systems. The laboratory provides a research environment for the development and design validation of flight data systems through the use of engineering development tools that include distributed systems, networks, advanced display and control technologies, sensor/effector emulations, integration analyses and system sensitivity studies.

Contact:
David M. Pruett
(713) 483-5269

Propulsion and Power — Propulsion research: rocket engine combustion and stability, low gravity fluid behavior, high temperature materials, propellant characterization, ceramic applications to small engines and valving, propulsion systems modeling, valving technology, and on-orbit health monitoring. Power research: energy conversion systems, including long life and high current density fuel cells and electrolysis systems, nickel-hydrogen and lithium batteries, photovoltaic and solar dynamic power systems, automated management and distribution, and thermal energy storage.

Contact:
Thomas Davies Power
(713) 483-9041

John Griffin
Propulsion
(713) 483-9003

Robotic Simulation — Development of kinematic/dynamic simulations of Shuttle and Space Station telerobots with interactive graphic interfaces is being actively pursued in support of real-time simulation and nonreal-time dynamic analyses. This includes control algorithms for kinematically redundant manipulators, joint servo modeling, control systems interaction, structural contact modeling, and development of simulation architectures. Other areas include multibody dynamic algorithm development (rigid and flexible bodies), friction modeling, and numerical techniques for their solution.

Contact:
Charles J. Gott
(713) 483-8107

Artificial Intelligence — Incorporation of advances in intelligent systems technology into space systems, organizations, and programs for the continual improvement of their effectiveness (safety, reliability, maintainability, cost efficiency, and operability).

Contact:
Kathleen E. Jurica
(713) 483-4776

Telerobotics and Autonomous Robotic Systems — Development of hardware/software upgrades to the Shuttle Remote Manipulator System, the integration of the Space Station Mobile Service Center and the Special Purpose Dexterous Manipulation into the Space Station for long term maintenance, and the development of advanced robotic systems and components to provide adaptive robots for long term autonomous missions in space and on lunar and planetary surfaces.

Contact:
Edith C. Taylor
(713) 483-1527

Robotic Applications — Development of emerging technologies, such as advanced control schemes (i.e., force/torque feedback and adaptive control), multiarm control (for both kinematically sufficient and redundant systems), external sensing, collision detection and avoidance, on-line path planning, remote control of multiple robots at diverse locations, and application of these technologies to mobile platforms and fixed hand manipulators.

Contact:
Charles R. Price
(713) 483-1523

Intelligent Robotics — Development of dexterous hands/arms to fulfill the future need for autonomous, dexterous robots. Current research efforts include the development of intelligent control systems for arms and hands, coordinated control of dual hand/arm systems, proximity/tactile sensor systems for adaptive grasping and manipulation, and neural networks.

Contact:
Charles R. Price
(713) 483-1523

Computer Graphics Research — Development of advanced graphics techniques for robotic real-time man-in-the-loop simulation development, as well as for video documentation of robotic scenarios. This includes research and development of algorithms such as radiosity and ray tracing, developing efficient graphics front ends to simulations which must run in real time, animation, geometric modeling, virtual reality, and telepresence.

Contact:
Charles J. Gott
(713) 483-8107

Space & Life Sciences

Biomedical and Nutrition Research — The present program seeks to define at the cellular and biochemical levels the key elements underlying the integrated physiological response to space flight, with the goals of defining and monitoring crew health and developing countermeasures. Flight-induced changes in fluid and electrolyte balance, orthostatic and cardiovascular function, erythropoiesis, and the musculoskeletal, immunological, and metabolic nutrition systems are being investigated *in vivo* using head-down bed rest, and *in vitro* using cell cultures.

Contact:
Helen W. Lane
(713) 483-7188

Endocrine Biochemistry — Ongoing projects include *in vitro* and *in vivo* studies of space flight-related perturbations to calcium, carbohydrate, and protein metabolism, sodium homeostasis, and the reninaldosterone response. Analytical methods are being developed for identifying hormone-binding proteins, antidiuretic hormone, atrial natriuretic hormone, and parathormone. Other methods are being developed to assess electrolytic and hormonal status noninvasively during simulated and actual space flight.

Contact:
Peggy A. Whitson
(713) 483-7046

Immune Responses to Space Flight — The purported detrimental effect of space flight on the immune system has far-reaching implications for maintaining crew health in space, particularly on long missions. Ongoing projects include characterization of receptors on peripheral-blood monocytes by flow cytometry and image analysis; analysis of the antibody response to microbial challenges *in vitro*; and characterizing changes in microbial physiology as they relate to the risk of infectious disease.

Contact:
Duane L. Pierson
(713) 483-7166

Biotechnology and Bioprocessing — Microgravity can be used to facilitate the separation and synthesis of medically important biological materials, as well as to enhance the formation of tissue-like aggregates in specially designed bioreactors. Theoretical and experimental projects are under way to improve cell-culture techniques using normal and neoplastic cell types under microgravity conditions.

Contact:
Clarence F. Sams
(713) 483-7160

Pharmacokinetic Research — Space flight appears to alter the disposition of drugs administered to crew members. Characterizing these changes is essential to design effective treatments for illnesses in flight. Bed-rest and in-flight studies are being conducted to identify the physiological changes that influence drug disposition; to develop simple, noninvasive monitoring procedures that can be used in microgravity; to develop computer models of pharmacokinetics; and to develop appropriate drug-delivery systems.

Contact:
Lakshmi Putcha
(713) 483-7760

Physiologic Research — Adaptation to space flight can affect human health and performance during space flight and on return to the influence of gravity. The laboratories of the Space Biomedical Research Institute conduct research involving several physiologic systems (cardiovascular, pulmonary, nervous, and musculoskeletal) to characterize these adaptations. Investigations are conducted both in flight and during ground-based simulations.

Contact:
Chuck Sawin
(713) 483-7202

Environmental Physiology/ Biophysics Research — The physiological and biophysical influences and interactions of environmental factors such as gas species and their partial pressures, temperature, gravity, decompression, and exercise are being investigated by the Environmental Physiology Laboratory. Experiments involving human subjects and mathematical models are pursued. The goal is the understanding of physiological problems and developing monitoring equipment.

Contact:
Michael Powell
(713) 483-5413

Psychological Research — The Behavior and Performance Laboratory conducts investigations to develop effective crew selection, training, and in-flight support procedures and guidelines for manned space missions. Toward this end, specific areas of study include stress and adaptation to extended confinement, team dynamics and leadership, team composition, methods of nonintrusive measurement, cognition, behavioral strategies, behavioral modeling, performance assessment, goal-setting, and preventive mental health.

Contact:
Deborah Harm
(713) 483-7222

Exercise Physiology — The Exercise Physiology Laboratory is intimately involved in investigations which support the Space Biomedical Research Institute. The investigators and engineers are also active in the development of future flight hardware for extended space flight. A major aim is to understand the degradations in exercise capacity and the role which exercise may play in the maintenance of normal function in other physiologic systems.

Contact:
Michael Greenisen
(713) 483-3874

Space Food Development — The Food Systems Engineering Facility supports food development activities for the Shuttle, Space Station, and future missions. Weight and volume of space food systems are critical and projects like Lunar Base and Mars missions require major efforts in food development. Research areas of interest include: food development, acceptability measures for microgravity and isolation, food bioregeneration, shelf life, preservation, packaging, and food waste management.

Contact:
Charles T. Bourland
(713) 483-3632

Space Radiation — Research in space radiation with the emphasis on the need for crew health protection. The experimental program involves passive dosimetry measurements with thermoluminescent detectors and active dosimetry measurements, which involve development of new charged particle detectors that are flown on the Shuttle. The theoretical program includes the study of and improvements in the trapped radiation belts models, the galactic cosmic radiation models, and studies related to solar energetic particle events.

Contact:
Gautam Badhwar
(713) 483-5065

Orbital Debris — This theoretical and experimental program includes understanding satellite breakups and other on-orbit sources of orbital debris. Models are developed which combine debris sources with natural sinks to describe the debris environment for both low Earth orbit and geosynchronous orbit. Measurements are conducted of debris physical properties and flux using optical, infrared, radar, and impacted surfaces from returned spacecraft. Hypervelocity guns are used to test spacecraft shielding concepts.

Contact:
Donald J. Kessler
(713) 483-5313

Planetary Materials Analysis — Research involves laboratory analysis of lunar rocks, terrestrial rocks, meteorites, and cosmic dust particles to unravel the early geochemical history of solid matter in the solar system, the geologic evolution of planets and rocky protoplanetary objects, including comets, to plan the technology for a lunar base, and for robotic missions to the moon, Mars, and asteroids. Remotely sensed data of Earth and other planetary bodies are also used for these same objectives.

Contact:
Gordon McKay
(713) 483-5041

Safety, Reliability, and Quality Assurance

Risk Management — Opportunities exist for research in the development and implementation of quantitative and qualitative techniques to identify the parameters of a comprehensive risk management program for complex space systems and facilities. Approaches include statistical modeling of failures and their effects; probabilistic risk assessment; fault tree, event tree, or decision tree analysis; and the dynamic integration of element hazards arising from both ground and mission phases.

Contact:
Richard Holzapfel
(713) 483-4290

Information Systems

Advanced Software Technology— Responsible for developing and evaluating advanced software technology in support of NASA institutional and mission operations. Current efforts include research into general purpose intelligent training systems, expert assistants, neural networks for machine learning and image/speech recognition, parallel/distributed systems, verification/validation techniques, computer aided software engineering (CASE), fuzzy logic, genetic algorithms, planning and scheduling technology, and knowledge capture technology.

Contact:
Robert Savely
(713) 483-8105

John F. Kennedy Space Center

Program Administrator:

Mr. Warren Camp
Manager, University Liaison
Mail Stop HM-CIU
NASA John F. Kennedy Space Center
KSC, FL 32899
(407) 867-3494

The John F. Kennedy Space Center, located near Cape Canaveral, Florida, is NASA's primary launch site. The center handles the preparation, integration, checkout, and launch of space vehicles and their payloads. Areas of research available for Graduate Student Researchers are in engineering and the Earth Sciences. Additional information concerning the following opportunities may be obtained from the program administrator.

Engineering

Advanced Programs—Technology development and application efforts related to launch and landing activities for space launch vehicles. Includes facilities which can withstand the unique environmental conditions on the Atlantic beach side of Florida, and the harsh components of the plume created by liquid and solid fueled rockets. Materials, structures, ground support equipment and development, and systems engineering for integrating these components are open for graduate student involvement. Laboratories, equipment, and NASA engineers and managers are available at KSC for these and other opportunities in electronics and instrumentation, non-destructive testing methods, material sciences, advanced software, and artificial intelligence in support of the launch environment.

Contact:
William Sheehan
DE-TDO/Chief, Technology Development and Commercialization Office
(407) 867-2544

Earth Sciences

CELSS Research — Breadboard Project includes crop growth and production, chemical allelopathy, microbial ecology, biomass conversion, and systems control and automation. May conduct short-term environmental response tests for community gas exchange and nutrient uptake.Learn to track gaseous and microbiological contaminants in a CELSS system. Biomass conversion research in extraction of water-soluble compounds from crop residue, enzymatic hydrolysis of crop residue cellulose, production of edible mycoprotein, conversion of organic particulates and soluble residues from all other reactors into microbial biomass, and aquaculture research. Robotic techniques for planting, culturing, and harvesting crops in a closed growth chamber.

Contact:
John C. Sager (407) 853-5142
Biological Research and Life Support Office, MD-RES

Environmental/Ecological Research — Research on effects of Kennedy Space Center operations on barrier island ecosystems. Studies also include monitoring and assessment of habitat management programs on vegetation, Federally-listed threatened and endangered species, and other protected species found on Kennedy Space Center's wildlife refuge, including Florida scrub jay, bald eagle, gopher,

tortoise, manatee, indigo snake, Florida beach mouse, and several species of sea turtle. Studies on use of geographic information systems (GIS) as decision support for environmental monitoring and management.

Contact:
William K. Knott
(407) 853-5142
Biological Research and Life Support Office, MD-RES

Space Biology

Plant Space Biology Research— Research on carbon exchange rates and carbohydrate metabolism of higher plants in response to gravity. Includes studies of plant growth with lighting systems proposed for spaceflight, such as high-output LEDs, effects of closed atmospheres and ethylene on plants, and development and testing of nutrient delivery and rooting systems for growing plants in microgravity.Studies on changes in gene expression in response to different factors of the spaceflight environment.

Contact:
Raymond M. Wheeler
(407) 853-5142
Biological Research and Life Support Office, MD-RES

Langley Research Center

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The mission of the NASA Langley Research Center is to increase the knowledge and capability of the United States in a full range of aeronautics disciplines and in selected space disciplines. The following information provides, by Group, an overview of the current disciplines in the Langley program. Specific research activities associated with each discipline are also included.

Research and Technology Group

The Research and Technology Group consists of approximately 800 scientists, engineers, technicians and support personnel who are responsible for performing basic research and technology development in a broad range of aeronautical and selected space disciplines. Through an interdisciplinary approach, the group produces proven and usable technology for aerospace and nonaerospace customers. The Research and Technology Group program includes the following types of research activities:

Aerodynamics — Opportunities for research in the aerodynamics area include subsonic aerodynamics, transonic aerodynamics, supersonic aerodynamics, full-scale Reynolds number technology, propulsion integration, take off and landing characteristics, applied CFD, wind tunnel operations, productivity improvements, and advanced test techniques.

Contact:
William P. Henderson
(804) 864-3520

Flight Dynamics and Controls — Opportunities to conduct theoretical and applied research in flight dynamics include hazard characterization, detection and avoidance, laminar flow control, high Reynolds number research, and configuration aerodynamics. In the area of controls and guidance, for both aircraft and spacecraft, opportunities exist in multi-disciplinary, nonlinear system analysis, design, and implementation, as well as crew station technology. Human factors issues are addressed through research in flight management and vehicle operations technology, advanced human and automation integration, improved cockpit/crew interfaces and decision aids. Research being performed in these areas is targeted for aircraft operating in all speed regimes, as well as to launch systems and orbiting spacecraft.

Contact:
Dana J. Dunham
(804) 864-5061
Flight Dynamics

Roland W. Bowles
(804) 864-2035
Hazards Characterization, Detection, and Avoidance

Kathy H. Abbott
(804) 864-8262
Human/Automation Integration

Douglas B. Price
(804) 864-6605
Spacecraft Dynamics, Guidance, and Control

James G. Batterson
(804) 864-4059
Vehicle Operations

Jack J. Hatfield
(804) 864-2012
Cockpit/Crew Interfaces

Claude Keckler
(804) 864-1718
Aircraft Guidance and Control

Fluid Mechanics and Acoustics — Opportunities are available in the areas of computational, theoretical and experimental fluid mechanics and acoustics. Fluid mechanics research addresses: the enhanced understanding of viscous flow phenomena including boundary layer transition, turbulence, and separated and vortical flows; modeling of transition, turbulence, and vortical flow phenomena; computational fluid mechanics including accurate and efficient algorithm development; innovative flow control concepts for reducing induced and friction drag, enhancing performance of future high-lift systems, and reducing/increasing mixing; advanced nonintrusive flow diagnostics, and computational multi-disciplinary design optimization systems. Acoustics research addresses the understanding, prediction, and reduction of the noise associated with subsonic and supersonic aircraft. This computational, theoretical and experimental research focuses on engine, rotor, and airframe noise as well as sonic booms generated by supersonic aircraft. Specific areas include: tilt-rotor/helicopter noise, fan and jet noise, propeller noise, laminar flow acoustics, acoustic response, interior noise, sonic fatigue, structural acoustics and noise propagation. The area of computational acoustics represents a major new research thrust.

Contact:
Jerry N. Hefner
(804) 864-3640

Clemans A. Powell
(804) 864-3640

Gas Dynamics — Opportunities for research in the gas dynamics area include experimental assessment and enhancement of hypersonic aerodynamic, aerothermodynamic, and fluid dynamic characteristics of future Earth and planetary aerospace vehicle concepts, entry vehicle aerothermodynamics, configuration technology, planetary mission support technology, aerodynamic and aerothermodynamic flight data analysis, integrated fluid-thermal structural analysis techniques, aerothermal loads experimentation including computational fluid dynamics, and hypersonic propulsion research.

Contact:
Allan R. Wieting
(804) 864-1359

Competitiveness — A major problem facing the aerospace industry is how to become more competitive. Decreased cost and increased value characterize competitiveness. This task is to concurrently examine, in the context of competitiveness, (1) the system by which we bring forth, sustain, and retire the aerospace product and (2) the system by which we bring forth, sustain, and retire that aerospace product system.

Contact:
Ed Dean
(804) 864-8213

Information and Electromagnetic Technology — Opportunities for research covering information acquisition, information processing and information display for aerospace applications. Information acquisition includes laser sensing, microwave remote sensing technology including electromagnetic analysis methods, far-field and near-field antenna measurements, compact range technology, and aircraft and spacecraft antenna technology. Information processing and computer technology research areas include optical data processing, solid-state memory technology, very high-speed information processing, concurrent processing and highly reliable and fault-tolerant systems.

Contact:
Jack E. Pennington
(804) 864-1596

Materials — The Materials Division conducts research on advanced materials and nondestructive evaluation (NDE) technologies for aircraft and spacecraft structures. Materials research includes development of high performance polymers, light alloys and composites, and the processing and manufacturing technologies required to improve performance and reduce weight and cost of aerospace structures. Service life testing is performed to establish durability of these materials under simulated aircraft and spacecraft service conditions. Analyses and modeling are performed to predict structural integrity and develop a fundamental understanding of failure mechanisms. Nondestructive evaluation techniques and methodologies are developed to inspect aircraft and space launch vehicle structures.

Contact:
Charles E. Harris
(804) 864-3449
Fatigue and Fracture of Metals and Composites

Howard G. Maahs
(804) 864-3084
Refractory Matrix Composites and Thermal Protection Materials

W. Barry Lisagor
(804) 864-3140
Advanced Light Alloy and Metal Matrix Composites

Terry L. St. Clair
(804) 864-4273
High Performance Polymers and Polymer Matrix Composites

Eric I. Madaras
(804) 864-4970
Nondestructive Evaluation Sciences
Ultrasonic Propagation and Scattering in Composites
Electronics Reliability Sciences

David E. Bowles
(804) 864-3095
Spacecraft Materials and Space Environmental Effects

Structures — The Structures Division conducts a wide variety of analytical and experimental research aimed towards the development of more efficient structures for aerospace vehicles — airplanes, helicopters, and space vehicles. Research studies focusing on multi-disciplinary design are carried out to synergistically couple a number of technical disciplines into aerospace vehicle design. In addition, analytical methods for improving structural analysis and design are developed and validated by experimental studies. New structural concepts for both metal and composite structures are developed and evaluated through laboratory testing. Additional research is conducted in integrating advanced structural and active-control concepts to enhance structural performance. Studies of landing and impact dynamics focus on increasing safety during ground operations and crash impact. Research in the aeroelasticity area ranges from unsteady aerodynamic theory development to wind-tunnel tests of flutter models. The division operates a number of major facilities. These include the Aircraft Landing and Dynamics Facility, the Impact Dynamics Research Facility, the Structures Laboratory, and Transonic Dynamics Tunnel.

Contact:
Eleanor C. Wynne
(804) 864-2934

Internal Operations Group

Supports the Center's research programs and project activities, with special emphasis on formulating and implementing major policies and programs relating to resources management, acquisition and contracting activities, data systems management and technical support services. Also includes the Center's Construction of Facilities program; all functions necessary to design, install, operate and maintain large mechanical and electrical systems, complex research facilities and equipment and test apparatus; all functions necessary to provide and maintain institutional buildings, structures, and grounds; all functions necessary to provide design, analysis, fabrication and operation of complex aerospace systems and research test articles; Centerwide electronic discipline for projects and programs; the operation and maintenance of the Center's central computer complex and simulation facilities; and all functions necessary to operate and maintain the Center's daily flight operations inclusive of aircraft and avionics maintenance, research pilot staff management, and direction of all related design, fabrication, testing, and certification of experimental flight control and display systems.

Electronic and Information Systems — To pioneer and provide technology, systems, and services in the areas of instrumentation, scientific computing, and simulation to sustain Langley's continued research preeminence and to manage the Center's major aerospace flight research projects. The following items represent active research disciplines:

Advanced Sensor Systems — Solid-state laser lidar systems, semiconductor detector, and high-temperature superconductor technologies for spaceflight applications.

Contact:
Norman Barnes
(804) 864-1630
Solid-State Laser Technology

William E. Miller
(804) 864-1720
Semiconductor Detector Technology

Leo D. Staton
(804) 864-1793
Lidar Systems Technology

Stephanie A. Wise
(804) 864-8086
High-Temperature Superconductor Technology

Preston I. Carraway
(804) 864-1894
UV and IR Detector Technology

Terri L. Lazarus
(804) 864-1572
Spectroscopy of Laser and Optical Materials

Measurement Science and Instrument Technology — Far-infrared sensor technology, electromechanical sensors, digital data systems, nonintrusive optical and laser measurements, optical and laser spectroscopy, mass spectrometry and gas chromatography, thermal measurements, structural dynamics and acoustics measurements, optical interferometry and photogrammetry techniques, and electronics applications.

Contact:
Ira G. Nolt
(804) 864-1623
Far-Infrared Sensor Technology

Thomas A. Shull
(804) 864-1837
Advanced Electronics Optical Data Storage

Robert L. Krieger
(804) 864-4654
Digital Data Acquisition

Reginald J. Exton
(804) 864-4605
Optical and Laser Spectroscopy

Billy T. Upchurch
(804) 864-4750
Mass Spectrometry and Gas Chromatography

Philip Brockman
(804) 864-1554
Solid-State Laser Systems

Glen W. Sachse
(804) 864-1566
In Situ Diode Laser Sensors

Tom A. Shull
(804) 864-1837
Advanced Electronics

Jerry H. Tucker
(804) 864-7342
Microelectronics and Microprocessors

Kamran Daryabeigi
(804) 864-4745
Thermal Measurements

John C. Hoppe
(804) 864-4618
Optical Interferometry Photography

James B. Miller
(804) 864-7101
Advanced Instrument Pointing, Tracking, and Scanning Systems

Vernie H. Knight
(804) 864-1658
Aircraft Data Systems

John K. Diamond
(804) 864-1668
Analog Signal Processing

Lorelei S. Gibson
(804) 864-4643
Pressure Measurements

William W. Hunter
(804) 864-4581
Laser Velocimetry

David L. Gray
(804) 864-4661
Electromechanical Sensors
Structural Dynamics and Acoustics Measurements

Advanced Computational Capability — Piloted simulation, computer generated scientific visualization, image processing, grid generation, and numerical techniques for high-performance scientific computers.

Contact:
Billy R. Ashworth
(804) 864-6449
Piloted Simulation

Norman Barnes
(804) 864-1630
Quantum Mechanical Modeling of Laser Materials

Frank C. Thames
(804) 864-5596
Flight Software Systems
Mass Storage Techniques
Scalable Computing Architectures

Jules J. Lambiotte
(804) 864-5792
Scientific Visualization
Image Processing
Grid Generation
Numerical Techniques for High Performance Scientific Computers

Engineering — Provides the engineering design and fabrication of flight hardware and research test articles and equipment; the planning and implementation of the Construction of Facilities program; and all institutional services in support of the aeronautical and space research programs of the Langley Research Center.

Mechanical Systems Engineering — Engaged in the design, analysis, development, and testing of research systems. These systems include spaceborne and aircraft experiments and instruments required to conduct the Langley Research Center research and technology program.

Contact:
Kenneth D. Hedgepeth
(804) 864-7008
Development and application of systems engineering tools and methods to space and aircraft flight research projects

John W. Cox
(804) 864-7171
Design and development of mechanical systems for space remote sensing instruments and technology experiments

Design of electro-mechanical components, structural systems, terminal control systems, mechanisms, and stable optic bench design

William W. Fernald
(804) 864-7081
Design and development of mechanical systems for aeronautics flight experiments

Design of mechanisms, structural systems, aircraft structural modifications, and instrumentation packaging

William S. Lassiter
(804) 864-7022
Systems level thermal, fluids, and structural analysis and verification of spaceflight and aircraft flight experiments

Application of finite element and finite difference methods including the development of CAE tools

Facility Systems Engineering — Engineer and design aerospace research facilities and equipment for aeronautical and space research including: wind-tunnel structures and systems, test sections, model supports, environmental chambers, heaters, coolers, mechanical drives, electrical drive machinery, and electrical distribution systems. High-temperature aerodynamic research for the National Aero-Space Plane (NASP) in the Langley 8-Foot High Temperature Tunnel, low temperature aerodynamic research in the National Transonic Facility, magnetic suspension control systems in the Active Control Test Facility, and landing loads at the Aircraft Landing Dynamics Facility.

Contact:
George W. Ivey
(804) 864-7286

David C. Beals
(804) 864-7179
Engineering and design of aeronautical and space research facilities

Structural finite-element modeling, dynamic structural analysis, heat transfer processes of research facilities, processes, and equipment

Engineering Laboratory Unit — Physical and chemical analytical testing services needed for the operation of facilities at Langley Research Center. Development of analytical instrumentation that will advance services at Langley Research Center or will advance technology in aeronautics and space projects such as instrumentation for environmental controls, inorganic analysis by X-ray fluorescence, flow field and temperature visualization for wind tunnel models, and superconductive materials aerospace utilization.

Contact:
Warren C. Kelliher
(804) 864-4172

Space and Atmospheric Sciences Program Group — The goal of the Space and Atmospheric Sciences Program Group is to conduct research that will establish and maintain a solid foundation of technology embracing all of the disciplines associated with space and atmospheric sciences and to provide a wellspring of ideas for advanced concepts. These programs include the following disciplines and specific research activities.

Stratospheric Aerosol and Gas Experiment (SAGE) — Analysis and interpretation of atmospheric aerosol, ozone, nitrogen dioxide, and water vapor measured from SAGE I (1979-81) and SAGE II (1984-present) satellite instruments. Studies are directed toward developing global climatologies of these species and understanding the role these species play in atmospheric processes such as ozone depletion and global warming.

Contact:
Lamont R. Poole
(804) 864-2689

Climate Research Program — Theoretical, laboratory, and field investigations of the radiative properties of natural volcanic and man-made aerosols and assessment of their impact on regional and global climate. Remote and in-situ observations of cloud properties and radiation balance components and theoretical studies of the role played by clouds in the Earth's radiation balance.

Contact:
Patrick Minnis
(804)864-5671

Tropospheric Chemistry Research Program — Assess and understand human impact on the regional-to-global-scale troposphere; define chemical and physical processes governing the global geochemical cycles from empirical and analytical modeling studies, laboratory measurements, technology developments, and field measurements; and exploit unique and critical roles that space observations can provide.

Contact:
James M. Hoell
(804) 864-5826

Upper Atmosphere Research Program — Expand the scientific understanding of the Earth's stratosphere and the ability to assess potential threats to the upper atmosphere. Includes developing empirical and theoretical models, formulating new instruments and techniques, performing laboratory and field measurements, and performing data analysis and interpretation studies.

Contact:
William L. Grose
(804) 864-5820

Measurement of Air Pollution from Satellites (MAPS) — Analysis and interpretation of measurements from an instrument developed to provide global tropospheric carbon monoxide data from the unique vantage of the Space Shuttle, with the opportunity for frequent flights.

Contact:
Henry G. Reichle
(804) 864-5383

Earth Radiation Budget Experiment (ERBE) — Analysis of measurements from instruments on three satellites that provide data on the Earth's radiation budget for assessing climatic impact of human activities and natural phenomena as well as a better understanding of all climatic parameters, in particular, the radiation budget components on a global scale.

Contact:
Bruce R. Barkstrom
(804) 864-5676

Halogen Occultation Experiment (HALOE) — Analysis and interpretation of measurements from this experiment on the Upper Atmosphere Research Satellite to improve understanding of stratospheric ozone depletion, particularly the impact of chlorofluoromethanes on ozone by analyzing global vertical profile data of O_3, HCl, CH_4, H_2O, NO, NO_2, and HF.

Contact:
John G. Wells
(804) 864-1859

Global Biogeochemical Cycling — Theoretical and field investigations of the biogeochemical cycling of atmospheric gases, with particular emphasis on the global budgets of oxygen, nitrogen, and carbon dioxide to better understand global change. Field measurements include studies of biogenic emissions of atmospheric gases from the soil and oceans and gases produced and released to the atmosphere during biomass burning, i.e., the burning of the world's forests and grasslands.

Contact:
Joel S. Levine
(804) 864-5692

Transportation Systems — Future space vehicle concept development, operations, research, and computer-aided design.

Contact:
Charles H. Eldred
(804) 864-8211

Spacecraft System Studies — Spacecraft concept development studies for Global Change science missions; large Earth orbiting spacecraft and platform systems studies; spacecraft subsystem analyses, performance, and technology assessments; mission design; and computer-aided design and simulations.

Contact:
Richard A. Russell
(804) 864-1935

In-Space Technology Experiments — Definition and development of flight experiments for the verification and validation of unique, innovative space technologies in the space environment or under microgravity conditions.

Contact:
Joseph C. Moorman
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Lewis Research Center

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The Lewis Research Center has a broad research program embracing aeronautical propulsion, space propulsion and power, space electronics, and microgravity science. Brief descriptions of some of the major research activities at Lewis follow.

Aeropropulsion Analysis

Aircraft Propulsion Systems Analysis — Advanced propulsion concepts are conceived and analyzed to estimate performance for typical flight vehicle applications, determine relative merits compared with alternative propulsion systems, and derive optimum designs of systems integrated with a vehicle. Also, analytical and numerical models that predict performance, noise, and weight of complete propulsion systems and components are developed, along with models of flight vehicles.

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Instrumentation and Controls Technology

Controls and Dynamics — Advanced digital electronic and fiber-based controls and systems are developed for air breathing and rocket engines, motivated by increased performance, operability, and durability requirements. Included in the scope of the research are control theory applications, real-time flight/propulsion simulation, integrated flight/propulsion controls, system life-extending controls, fiber-optic and electro-optic control components, and robust fault-tolerant controls and systems. Application of neural networks to controls and advanced dynamic modeling and modeling methodologies are active research areas also.

Contact:
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Optical Measurement Systems — Optical instrumentation technology is developed for aerospace propulsion R&D requirements, with emphasis on laser-based techniques for nonintrusive gas path diagnostics and structures measurements. Both point and whole-field measurements of parameters such as velocity, temperature, and species concentration in rotating turbomachinery and combustors are obtained using laser anemometry, laser spectroscopy, Rayleigh/Mie scattering, interferometry and other techniques. Optical systems and image processing techniques developed in the Division's laboratories are demonstrated in Center research facilities.

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Sensors — Research sensors are being developed to support a wide variety of applications which include materials development, structural testing, aero-thermal-structural code validation and propulsion component and system performance testing. The desired characteristics for research sensors are high accuracy, high reliability, and survivability. Increasingly hostile measurement system environments make the achievement of these characteristics a major challenge.

Measurements of current interest include material surface temperature, strain, heat flux, gas temperature, and gas species.

Contact:
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High Temperature Electronics Technology — Development of silicon carbide-based, solid-state electronic device technology for high temperature, high radiation, and high power applications, such as advanced aerospace propulsion and power systems. Basic and applied research efforts include silicon carbide crystal growth techniques and all areas of device fabrication technology.

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Internal Fluid Mechanics

Computational Fluid Mechanics — Development and application of new techniques for analysis of subsonic, supersonic, and hypersonic aerospace propulsion system flows associated with inlets, nozzles, compressors, turbines, combustors, augmentors, and rocket systems. Research is also conducted in the numerical simulation of fluids in the space environment, including such phenomena as rarefied gas flows, microgravity effects on free surfaces, g-jitter effects on fluid mixing, and microgravity combustion. Emphasis is on numerical methods with greater accuracy and significantly increased convergence rates. Of increasing importance are computational strategies using such concepts as multiblock grids and zonal approaches combining two or more numerical methods. Pacing items for advanced applications are three-dimensional complex geometry mesh generation techniques, grid lattice construction, and solution-adaptive mesh clustering. Three-dimensional turbulent flow fields with emphasis on turbulence models are of continuing interest. An expanded and focused effort on developing, validating, and applying advanced turbulence models for propulsion flow physics is a growing research activity.

Contact:
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Computational Technology — Development and application of advanced computer hardware and software to the simulation of flows associated with aerospace propulsion components and systems. Included in the scope of the research is the synthesis and benchmarking of parallel computer architectures and algorithms for solving 3-D steady and unsteady flow problems, the use of expert systems as intelligent interfaces to large computer codes, the use of parallel processing and interactive graphics techniques for on-line visualization of computation results, and experimental data and improved data handling software for distributed computing environments.

Contact:
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Experimental Fluid Mechanics — Experiments to verify selected fluid mechanics computations and to advance understanding of flow physics, heat transfer, and combustion processes fundamental to aerospace propulsion. Experimental data are analyzed to aid development of aerothermodynamic models embracing combustion thermodynamics, reaction chemistry, and turbulence. State-of-the-art experimental facilities, instrumentation, and data acquisition, reduction, and analysis methods and facilities are employed

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Aeronautical Propulsion Systems

Hypersonic Propulsion Technology — Analytical and experimental research directed at the aerodynamic design of hypersonic propulsion systems and their integration with the airframe. Work includes analysis and test on inlets, nozzles, combustors, and other critical components. Experimental efforts include design of model and instrumentation. New theoretical flow analyses, which include 3-D shock/boundary layer interactions, are applied to the design and evaluation of experiments.

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Emissions Technology — Experimental and analytical research to advance the understanding of emissions formation in combustion processes in subsonic and supersonic gas turbine aircraft engines. Research includes experiments in flame tube and sector combustors using advanced diagnostics. Analytical work involves using KIVA II and ALLSPD computer codes to predict combustion emissions and compare with on-going

experimental results. State-of-the-art experimental facilities, instrumentation, analysis methods and computational facilities are employed.

Contact:
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Aircraft Icing — Analytical and experimental efforts devoted to developing novel concepts for aircraft ice protection, and fundamental experiments to understand and model the physics of ice formations. Changes in aircraft performance with ice buildup on unprotected components are quantified. Extensive aerodynamic and thermodynamic numerical models are developed and utilized.
Interdisciplinary efforts are devoted to developing instruments to characterize icing cloud properties, measure ice accretion on surface, and detect changes in aircraft performance in icing conditions. Experimental research is conducted with a specially equipment Twin Otter aircraft and in the Lewis Icing Research Tunnel, the largest refrigerated icing tunnel in the world.

Contact:
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Aircraft Power Transfer Technology — Power transfer technology for advanced propulsion drive systems having higher power-to-weight ratio, longer life, higher reliability, lower noise, and higher efficiency. Areas under study include design optimization, new gear arrangements and tooth forms, materials, lubrication, and cooling. New analytical tools for stress analysis, vibration, lubrication, and high-speed gears are being developed. A full-scale helicopter transmission test rig is available, as are facilities for fundamental studies of lubrication, endurance, efficiency, noise of spur and bevel gears, and planetary gear sets.

Contact:
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Low Noise Nozzle Technology — Analytical and experimental research on exhaust nozzle aerodynamics and acoustics for high speed commercial transport applications. The goal is to achieve takeoff noise levels competitive with the best subsonic engine technology. Advanced 3-D full Navier Stokes computational methods are used for nozzle flow analysis and performance predictions. Acoustic analyses utilize time and frequency domain acoustic analogy models in conjunction with aerodynamic predictions. The more promising nozzle concepts are evaluated experimentally in large dedicated facilities where aerodynamic performance, near and far field acoustic performance, and flow details via advanced flow diagnostics can be determined.

Contact:
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Turbomachinery Technology — Research to advance turbomachinery technology for gas turbine engines for a wide range of civil and military applications. Areas addressed include advanced axial and radial compressors and turbines as well as innovative components such as wave rotors. Research interests include cavity flows as well as main stream flows. Turbine research includes internal coolant flows and film cooling. Involved are flow visualization, detailed flow field and heat transfer measurements, computer code development, and performance modeling.

Contact:
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High Performance Aircraft Propulsion Technology — Research on propulsion systems for advanced high performance aircraft, including highly maneuverable fighters and short takeoff/vertical landing fighters. Included are theoretical analyses and experimental investigations of individual components and complete systems. Novel propulsion concepts are evaluated and research is performed to develop key technologies. Research includes analytical studies, application of advanced design codes, and planning and execution of experimental programs.

Contact:
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Fan Aerodynamics and Acoustics — Analytical and experimental investigations of the aerodynamics and acoustics of turbofans. Advanced CFD and CAA methods are applied and compared to experimental data from model scale tests. Noise predictions are made using time and frequency domain acoustic analogy models in conjunction with aerodynamic predictions. Aerodynamic modeling emphasizes integration of fan, nacelle and core flow on system performance and acoustic radiation. New fan concepts are developed and evaluated for high performance and low-noise characteristics.

Contact:
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High Performance Computing and Communications/Numerical Propulsion System Simulator — Development of a propulsion system simulator involving the integration of disciplines, components, and high performance computers into high level software environment. Of particular interest is the structuring of object oriented component models within a data flow control network. The numerically intensive component models will employ various parallel processing strategies to speed the overall system processing times. Various algorithms will be explored to solve complex geometry, time varying, engine system problems on a heterogeneous network of computers.

Contact:
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Materials

Microgravity Materials Science — Fundamental research to understand the effect of gravity on materials processing as it influences convection, buoyancy, sedimentation, and hydrostatic pressure. Central to this effort is the Microgravity Materials Science Laboratory, which is used by scientists to develop experiments for eventual flight on the Space Shuttle. The laboratory develops advanced flight hardware and supporting equipment for processing and analysis of metals, ceramics, glasses, and polymers. Areas of research include directional solidification, telerobotic control, flow diagnostics, macro- and micro-segregation, undercooling, sol-gel and containerless processing, and crystal growth. A significant portion of this effort is being directed to computational modeling of growth processes as they are influenced by gravity. The laboratory includes an extensive computational and graphical display facility.

Contact:
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Ceramic-Matrix Composites — Development of structure/processing/property relationships of ceramic-matrix composites including fibers and fiber coatings for high-temperature, high-reliability requirements for advanced aerospace propulsion and power applications. Various processing approaches, including polymer pyrolysis, melt infiltration, and sol-gel processing, are being pursued. Properties of interest include flaw distribution, phase morphology, strength, toughness, crack initiation and propagation characteristics, and resistance to environmental attack.

Contact:
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Tribology — Research to gain a fundamental understanding of the lubrication, adhesion, and wear phenomena of materials in relative motion that meet increased speed, load, and temperature demands of advanced aerospace propulsion and power systems. Both synthesized liquid lubricants and solid lubricants created by plasma film deposition techniques are under study. Tribological behavior is investigated in situ using a variety of techniques including Auger electron, X-ray photoelectron spectroscopy, and infrared microspectroscopy.

Contact:
Stephen V. Pepper
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Polymers and Polymer Matrix Composites — Development of advanced polymers and polymer matrix composites for use in aerospace propulsion and power and space communications systems. Areas of research include polymer synthesis, characterization, and processing; composite processing, characterization and evaluation; interface studies; polymer/composite aging and life prediction; and determination of structure/property relationships. Research is interdisciplinary and involves work in organic and polymer chemistry, physics, chemical engineering, materials science and engineering, and mechanical engineering.

Contact:
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Environmental Durability of Advanced Materials — Research to understand the mechanisms of material degradation and to develop approaches to improve the durability of material systems for advanced turbines. Of particular interest are high temperature chemistry, environmental effects and the development of coatings for metals, intermetallics, and ceramics and their composites. Chemical vapor deposition (CVD), physical vapor deposition, and plasma spray processes are used in developing coatings. Modeling efforts complement experimental activities in TBC and in environmental degradation studies.

Contact:
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Metal Matrix and Intermetallic Matrix Composites — Development of advanced materials, such as metal matrix composites, intermetallic compounds, and superalloys, and innovative processing concepts, such as rapid solidification, arc spraying, and laser fiber growth for application to aerospace propulsion systems having improved performance, higher temperatures, greater durability, and lower cost. Microstructure/property relationships are being developed and experimentally verified. Advanced analytical and microscopy techniques are employed.

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Structures

Advanced Composite Mechanics — Research for development of theories, computational algorithms, and requisite computer codes for the mechanics, analysis, and design of propulsion structures made from high temperature composites. Of interest are polymer matrix, metal matrix, ceramic matrix, and carbon-carbon composites. Research focuses mainly on specialty finite elements for micromechanics and laminate theory; improved theories for life and durability prediction under hostile environment and long time exposure effects; probabilistic composite mechanics; and integrated computer programs for component-specific analysis and design, progressive fracture, acoustic fatigue, damping and high-velocity impact. Selective experimental research is conducted in support of theoretical developments.

Contact:
Christos C. Chamis
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Concurrent Engineering Simulation — Research for developing integrated software packages for the computational simulation of multidisciplinary procedures through which propulsion structural systems are developed, conceived, designed, fabricated, verified, certified, installed, and operated (concurrent engineering). Of interest are simulation models and software packages which consist of: (1) workstations with discipline-specific modules, dedicated expert systems, and local databases; (2) a central executive module with a global database with communication links for concurrent interaction with the multidiscipline workstation; (3) unsupervised-learning neural nets; (4) adaptive methods for condensing and incorporating information as the system evolves; (5) zooming methods; (6) graphic displays; and (7) computer-generated tapes for numerically controlled fabrication machines.

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Probabilistic Structural Mechanics — Research for developing probabilistic structural mechanics, solution/computational algorithms, and requisite computer codes to quantify uncertainties associated with the parameters and variables required for structural analysis and design for both serial and parallel composites. Research focuses mainly on developing probabilistic theories and models for coupled thermal-mechanical-chemical-temporal structural behavior of propulsion structures made from high temperature materials and including metal matrix, ceramic matrix, and carbon-carbon composites and implementation in serial and parallel machines.

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Christos C. Chamis
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Computational Structures Technology — Development, integration, and demonstration of technology to enhance the role of computational modeling in the design and development process for propulsion and power system structural components. Both efficiency and credibility of computational modeling are of concern so technologies that streamline the design/analysis process as well as improve the fidelity of computational predictions are of interest. Specific areas of interest include computer-integrated simulation, multidisciplinary computational mechanics, design optimization, and artificial intelligence. Simulation includes object-oriented technology, information models, product schema, distributed computing, virtual reality, and human interfaces. Computational mechanics includes fundamental mechanics principles, discrete solution methods, and parallel computing algorithms. Design optimization includes mathematical programming and optimality algorithms, heuristic methodology, and multidisciplinary design. Artificial intelligence includes expert systems and neural network applications.

Contact:
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Structural Dynamics — Development of fundamental methods for predicting and controlling the dynamic response and stability of aerospace propulsion and power systems. High-speed rotation provides a central focus for much of the work. This includes studies of the aeroelastic response of bladed disk systems, both active and passive methods for controlling the vibration and stability of high-speed rotor-shaft systems, and

modal analysis methods for highly damped large scale periodic structures. Actively controlled bearing supports are being developed to allow higher speed and lighter weight aeropropulsion system design. Technology for long life mechanical components for space mechanism designs to enable long duration space missions. Innovative computational methods that exploit parallel computers and modern computer science principles are being applied.

Contact:
George L. Stefko
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Structural Integrity — Research to assure integrity and reliability of aerospace propulsion and power systems and structural components. Areas of emphasis include interrogational methods for avoiding catastrophic fracture, fault-tolerant design, defect assessment, and residual life prediction. Comprehensive life prediction models are sought that incorporate complex stress states, nonlinear material characteristics, microstructural inhomogeneities, and environmental factors. Structural integrity is verified by nondestructive characterization of microstructure, flaw population, material morphology, and other relevant factors. Nondestructive evaluation is carried out using analytical ultrasonics, computed tomography, laser acoustoultrasonics, and other advanced interrogational technologies. Modern computer science practices are exploited to the fullest, and emphasis is on advanced structural ceramics and composites. Integrated computer programs for predicting reliability and life of brittle material components are generated.

Contact:
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Deformation and Damage Mechanics — Theoretical and experimental studies of deformation and damage mechanics are conducted to develop accurate methods for determining the deformation response and assessing the useful life of structural components operating at elevated temperatures. Typical examples include turbine vanes, blades, and disks; rocket motor combustion chambers, turbines, and nozzle liners; and hot sections of space and terrestrial power systems. Multiaxial, nonproportional, and nonisothermal loading conditions all prevail in such structures. Research focuses on developing (1) constitutive equations, (2) numerical algorithms for analysis and design, and (3) experimental validation of proposed theories and characterization of material response. Materials under investigation include polycrystalline, single crystal, and directionally solidified metals and their alloys; ceramics; and metallic-, intermetallic, and ceramic-matrix/fiber reinforced composites.

Contact:
J. R. Ellis
(216) 433-3340

Fatigue Life Prediction — Both analytical and experimental approaches are used to develop accurate techniques for predicting durability of aerospace components (turbine vanes, blades, disks, rocket nozzle liners, etc.) subjected to complex service loadings. These are subjected to severe cyclic loads in high-temperature environments. Temperatures are high enough to introduce creep, relaxation, metallurgical transformations, and oxidation. The behavior of materials and structures subjected to such environmental factors is studied in the laboratory, and techniques are developed to allow reliable life prediction in advance of service. Materials under investigation include monolithic alloys and ceramics; and newly developed metallic, intermetallic, and ceramic matrix/fiber reinforced composites. Fully equipped, computer controlled test systems allow rational behavior to be investigated under uniaxial and biaxial stress states. Also, advanced scanning electron microscopes, transmission electron microscopes, and microprobe facilities are available to investigate fatigue mechanisms at the microstructural level.

Contact:
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Space Propulsion Technology

Liquid Rocket Propulsion — Research to better understand the basic physical and chemical processes in liquid rocket engines. Disciplines include high-energy propellant chemistry, ignition, combustion, heat transfer and cooling in thrust chambers, nozzle flow phenomena, and performance. Of particular interest are the fundamentals involved in combustion, cooling, bearings, seals, expert systems applications to propulsion, and nonintrusive diagnostics. Work is conducted through detailed analytical and experimental programs to determine feasibility or applicability and to develop and validate models to describe the processes.

Contact:
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Propulsion System Health Management — Research is required to develop improved and automated methods for the detection and isolation of anomalous behavior of propulsion systems and other launch vehicle subsystems. Efforts are currently focused on the Space Shuttle subsystems and Expendable Launch Vehicles. Emphasis is on real time detection and diagnosis of propulsion system and sensor failures, and automated post-test diagnostics. Research opportunities include application of pattern recognition techniques for fault detection/diagnosis, analytical redundancy for sensor validation, the development of generic feature extraction algorithms, automated diagnosis using expert system and model-based reasoning, and the development of quantitative and qualitative models for fault prediction.

Contact:
Sol H. Gorland
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On-Board Propulsion — Research on electric and chemical propulsion concepts that are candidates for a broad range of low-thrust, space propulsion functions. The electric propulsion effort includes arcjets, plasma rockets, and electrostatic concepts. The low-thrust chemical propulsion effort is focused on very high-performance and long life storable and hydrogen/oxygen rockets at thrust levels up to about 100 pounds. Efforts are directed toward understanding the fundamental phenomena and extending the performance and life of the various concepts.

Contact:
David C. Byers
(216) 977-7543

Molecular Computational Fluid Dynamics — Research on molecular computational fluid dynamics for the plumes, nozzles, and higher density plasma and combustion zones of low-thrust chemical and electric propulsion concepts. Efforts include research on (1) improved computational concepts, including effective use of parallel processing; (2) advanced physics models, including trades between interaction physics and speed of calculations; and (3) experimental tests to assist in development and validation of codes. Both neutral and charged flows will be studied to both describe and, where appropriate, assess the impact of those flows on spacecraft functions and subsystems.

Contact:
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Power Technology

Photovoltaic Space Systems — Fundamental and applied research to increase the efficiency, reduce the weight, and extend the life of solar cells for space applications. Emphasis is on III-V compounds, i.e., InP and GaAs. However, amorphous silicon and other thin film materials systems are also of interest. Activities include materials studies; investigations of radiation damage effects; device design, fabrication, and testing; and the development of related component technologies such as interconnects and optical concentrators.

Contact:
Dennis J. Flood
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Electrochemical Space and Storage — Development of advanced technology to increase the life and energy density of energy storage systems and fuel cells. Emphasis is on nearer-term nickel-hydrogen, metal-hydride and hydrogen-oxygen regenerative fuel cell systems, with exploratory efforts being given to more advanced high-temperature ionic conductor systems. Pre-prototypes of advanced battery systems are being designed, built, and tested.

Contact:
Marvin Warshay
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Space Power Management and Distribution Technology — Technology development to control the generation and distribution of electrical energy in aerospace systems and to define enabling technology for future power aerospace systems. Advanced electrical power systems and circuits and fundamental physics of electrical devices (insulators, conductors, and semiconductors) are investigated under this program. Prototype devices and circuits are fabricated, characterized, and analyzed. Research in system autonomy, system architecture, and fault prediction are important elements of the program.

Contact:
Robert W. Bercaw
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Power Systems Technology — Program management and technology for efficient, compact, lightweight, longlife power systems from hundreds of watts to megawatts for small spacecraft; high altitude, long endurance unmanned air vehicles; and clean car/super car applications. System and mission studies for space, terrestrial, automotive and aero power systems are conducted to identify requirements and technology needs in the areas of energy conversion, thermal management, power conditioning and control, materials and environmental effects.

Contact:
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Stirling Dynamic Power and Refrigeration Systems — Development of technology to explore the unique potential of the Stirling cycle engine and heat pump for both space and terrestrial applications. Principal emphasis is on developing the free-piston Stirling engine for space-power systems and advanced technologies for cryogenic space refrigeration systems. Among the areas of research are oscillatory flow and heat transfer, heat pipes, materials, non-contacting bearings, dynamic balancing, linear alternators and motors, and insulation.

Contact:
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Space Environmental Interactions — Research on electrostatic and electromagnetic effects in space systems and instrumentation induced by interaction with space plasma and field environments and on the characterization of local plasma and field environments around large space systems. Effects include surface and bulk dielectric charging, plasma sheath development, current collection from plasma, arcing, and the stimulation and propagation of disturbances. Research disciplines include: plasma, solid-state, and surface physics, electro-magnetism, and space system design fundamentals.

Contact:
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Power Materials Technology — Development of new or improved environmentally durable power materials, high emittance radiator surfaces, high reflectance or transmittance solar concentrators, high thermal conductivity materials, and high electrical conductivity composites. Evaluations of functional performance and durability are conducted for exposure to atomic oxygen, ultraviolet radiation, vacuum thermal cycling, and effects of interactions with lunar and Martian dust.

Contact:
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Solar Dynamic Power Systems — Development of technologies for lightweight, high efficiency solar dynamic power systems. Present emphasis is on the advancement of solar concentrator and heat receiver technologies. Specific concentrator emphasis is on lightweight construction, high reflectance surfaces, and protective films. Heat receiver emphasis is on a heat pipe cavity design with thermal storage. A system ground test in 1994, will demonstrate and evaluate existing solar dynamic technologies and identify areas for future development.

Contact:
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Thermal Management Technologies — Analytical and experimental efforts to develop the technologies for high performance heat transport components and systems. Concepts under investigation include ultra high conductivity composite materials for space radiators, direct immersion heat pipes for cooling electronics, and heat pipe components and systems for aircraft de-icing. A test facility for evaluating the steady state and transient performance of high temperature, high power heat pipes is under development.

Contact:
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Solar Array Power — Development of new or improved planar and concentrator array technologies, components, and concepts for small spacecraft that are efficient, stowable, lightweight, long-lived, and less costly than present systems. Array design features of interest include optical, electrical, thermal and mechanical elements. Test, analysis and development activities also support large spacecraft arrays including structural analysis of deployment mechanisms, testing system operation in simulated space environments, and studies of new array concepts.

Contact:
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Space Communications Technology

Space Communications Systems Analysis — Studies of advanced space communications to define future system concepts and technology requirements. Studies include investigation of new communications system architectures and networking concepts, analysis of interoperability of advanced satellite and terrestrial systems, and exploration of new ways to increase the available spectrum/orbit communications capacity. Involved are computer modeling of telecommunications networks and simulation of communications links. Laboratory research is conducted on digital television coding to reduce bandwidth requirements.

Contact:
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Vacuum Electronics — Research on vacuum electronics to improve the efficiency, operating life, and communications qualities of electron beam devices for use in space communications. Specific technologies of interest are electron emission (including thermionic, field and secondary emission), electron beam formation and control, electromagnetic/electrodynamic computer modeling and design, application of microfabrication to vacuum devices, and microwave power modules. State-of-the-art experimental and computational facilities are available.

Contact:
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Digital System Technology — Research and advanced digital technology development for space communications focused on modulation and coding, onboard switching and routing, network technologies, and intelligent systems applications. Specific technologies being developed include: bandwidth and power efficient digital modems and codes; multichannel demultiplexer/demodulators; multichannel ECC decoder; multichannel signal processing satellite architectures; onboard circuit and fast packet information switching; intelligent tutoring and assistance; fault detection and isolation.

Contact:
Joseph L. Harrold
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James M. Budinger
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MMIC Technology — Research to establish the technical feasibility of advanced solid-state devices and circuits. Research is focused on technologies in support of monolithic microwave/millimeter wave integrated circuits for transmitter and receiver modules. Areas of interest include transmission media, circuit analysis, device modeling, materials growth, and characterization. Materials of interest include III-V semiconductor heterostructures (GaAs, InGaAs, InP, AlGaAs). Also under investigation is the application of high temperature superconductors to microwave and millimeter wave electronics, princi pally in the areas of antennas and receivers.

Contact:
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Phased Array Antenna Technology — Research and advanced development of phased arrays for space communication systems for commercial applications and NASA missions. Emphasis is on development of K/Ka-band arrays/array feeds in which distributed monolithic microwave integrated circuit (MMIC) devices provide amplitude and phase weighing. Principal thrusts are on MMIC insertion technologies, including MMIC packaging; printed circuit radiating elements and beam forming/combining networks; and fiber optic links in arrays, as well as on system level integrated circuit development for array applications.

Contact:
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Space Experiments

Microgravity Science and Applications — Basic science experiments designed to capitalize on the microgravity environment of the Space Shuttle in the areas of combustion, metals and alloys, fluid physics and transport phenomena, ceramics and glasses, and electronic materials. Science requirements and conceptual designs are developed using ground-based 2.2 second and 5 second drop towers and DC-9 and Learjet aircraft. Activities culminate in the design, fabrication, and flight of space experiments.

Contact:
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In-Space Technology Experiments — In-space experiments to support advancement of the technology base in the areas of fluid management, energy systems and thermal management, and satellite communications. Areas of investigation include on-orbit fuel storage and transfer, low-gravity fluid behavior and thermal processes, instrumentation, and spacecraft fire safety. While ground-based precursor studies are pursued, emphasis is on the definition and development of cost-effective flight projects that yield results otherwise unobtainable through ground-based experiments or analysis.

Contact:
Olga D. Gonzalez-Sanabria
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Advanced Space Analysis

Advanced Space Analysis — Advanced planning studies and system analysis in areas of space power and space propulsion are performed to identify and support projects of interest to the Center. Research activities in power and propulsion applications as well as research in relevant analytic techniques are of interest.

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George C. Marshall Space Flight Center

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The Marshall Space Flight Center offers opportunities for original work in many areas of physical sciences, mathematics, and engineering. Theoretical and experimental research is greatly enhanced by the ready access to computers, including the Cray XMP.

Before preparing your proposal, prior discussion with a Center researcher is recommended. In general, Marshall advisers are interested in collaborative efforts with students and their university advisers and will look favorably on proposals which indicate that research time will be spent on-site at the Center.

Astrionics Laboratory

Electrical Systems — Activities include development of photovoltaic array systems, battery technology and application, and electrical power system automation. Research is conducted in improved photovoltaic cell design and testing. On-site resources include a photovoltaic test laboratory for simulation of on-orbit conditions. Research and application of electrochemistry is utilized to improve space flight batteries with life cycle testing and destructive physical analysis. Artificial intelligence approaches are used to support electrical power system automation.

Contact:
R. Bechtel
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Electronics and Sensors — Re-search, design, and development of activities are conducted on electronic control systems and measurement sensors for the guidance, navigation, and control of space vehicles. Subjects addressed are sensors, transducers, control actuators, reaction wheels, and pointing systems.

Contact:
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Optical Systems — Opportunities exist for research, development, and application of technology in the following areas: coherent lidar systems (both gas and solid-state technologies), target and detector calibration, transmitter evaluation, signal processing atmospheric propagation and system modeling; video/film camera systems, including imaging systems development, fiber optics, video compression, radiometry, film camera, and video system evaluation; and optical design, fabrication and testing including stray-light analysis and testing, performance analysis, coating metrology, precision engineering and binary optics.

Contact:
J. Bilbro
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Audio Systems — Design, development, and evaluation of flight audio communications systems are performed in support of ongoing and future programs. Specific areas of interest include digital signal processing and encoding techniques, voice synthesis and recognition, and the effect on background noise on intelligibility.

Contact:
P. Clark
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Communications Systems — Test facilities are available to pursue research and development of antenna components and systems. These facilities include a fully automated kilometer pattern test range and a shielded anechoic chamber with 3.7 meter diameter quiet zone and supporting test equipment operating up to 60 Ghz. Other areas of interest include high-power, solid-state transmitters and spread spectrum receivers.

Contact:
L. Bell
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Software Systems — An area of high interest is the automatic generation of digital computer code from structured requirements. An area of particular interest is definition of a set of integrated computer aided support tools for software development from requirements phase through validation for embedded computer systems. Another target area of research and development is artificial intelligence techniques and tools to aid in fault diagnosis, load management, and scheduling for flight systems and subsystems.

Contact:
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Battery Cell Analysis — Opportunities exist for research into the development of chemical and electrochemical techniques for analysis of aerospace battery cells. These include the modification of analytical techniques to minimize the amount of chemical waste produced and the development of electrochemical impedance spectroscopy as a tool in cell analysis. An important task in the latter is the development of an electrochemical model to be used in interpretation of spectra.

Contact:
D.H. Burns
(205) 544-4807

Materials and Processes Laboratory

Major research efforts are underway in physics and chemistry of metallic and nonmetallic materials in critical environments (cryogenic to high temperature) and new and improved techniques for developing spacecraft hardware. Comprehensive research and development activities are pursued in qualification and testing of materials and processes.

Space Environmental Effects on Materials — Evaluation of material is accomplished in simulated space environments involving vacuum, temperature, electron/proton, and UV irradiation, atomic oxygen, and micrometeoroid impact. The effects of outgassing products of materials on weight loss, strength loss, surface properties, and redeposition and condensation on other items are being studied. Studies involving lubrication and surface physics of bearings in space and in rocket propulsion components are also being conducted. Research and development in new nondestructive evaluation (NDE) methods/processes and instrumentation are encouraged.

Contact:
P. Schuerer
(205) 544-2481

Metallic Materials — Development of advanced materials for special applications in propulsion systems is ongoing. The materials include aluminum-lithium metal matrix composites and hydrogen resistant alloys. The effect of high-pressure, high temperature hydrogen on metals is an area of special emphasis. Research in microstructural analysis methods is being accomplished in support of failure analysis and fracture mechanics programs. Methods are being developed for quantitatively determining the state of corrosion, stress corrosion, and hydrogen embrittlement of alloys. Several ongoing efforts exist relative to advanced welding methods, intelligent processing, robotics, and the development of sensors for chemical and welding process controls.

Contact:
P. Munafo
(205) 544-2566

Nonmetallic Materials Research — Opportunities exist to develop and modify polymers for adhesive, elastomers, insulators, composite matrices, and molding and extrusion compounds for use in spacecraft hardware and in special environments. Organic composite such as carbon-carbon and carbon-resin are being developed for structural applications to reduce mass or for high-temperature applications such as rocket engine nozzles and leading edges. Research and development activities are being conducted to evaluate new analytical chemistry techniques or instrumental methods to assist in determining material properties under various temperatures, pressures, and environments. Analysis of waste, ground, and storm waters, soils, air, etc is performed in accordance with EPA guidelines. In addition, ceramics and glasses with special optical properties for use in spacecraft are being studied. Major research and technology efforts are underway in composite material fabrication, testing, and qualification for flight hardware application. Composite methodologies include automated filament winding and tape laying, pultrusion, tape warp-

ping, fiber placement, and hand lay-up. Additional opportunities exist relative to the development, application, and evaluation of cryogenic and high temperature thermal protection materials used in association with both liquid and solid propellant rocket motors. Opportunities also exist in the development of environmentally acceptable cleaning materials for use in the fabrication of components for launch vehicles.

Contact:
C. McIntosh
(205) 544-2620

Propulsion Laboratory

Activities are directed toward the research, technology, and flight hardware development of propulsion systems for launch and space vehicles and support equipment. Areas of activity include liquid and solid propulsion and control systems for the Space Shuttle, space propulsion and support systems, advanced chemical and nuclear propulsion systems for future launch and space vehicles, and flight experiment and space station mechanisms.

Systems Division — Research and development is ongoing in liquid propulsion systems and reaction control systems. Activities include predicting, analyzing, designing, and evaluating propulsion system and launch vehicle performance, and establishing test, integration, and verification requirements for flight and test bed propulsion systems. Special emphasis areas are zero- and low-gravity propellant systems and Shuttle main propulsion systems.

Contact:
L. Jones
(205) 544-7094

Component Development Division — Activities involve research and development for mechanical sub-systems such as propulsion feedlines, turbomachinery, combustion devices, thrust vector control, auxiliary propulsion, valves, actuators, controls, mechanisms, and environmental control and life support hardware. Another area of interest is establishing test, integration, and verification requirements for mechanical elements.

Contact:
C.S. Cornelius
(205) 544-7130

Combustion Devices and Turbomachinery — Investigation of combustion stability, performance, and heat transfer of large rocket engine thrust chambers are of special interest. Techniques for understanding the failure and wear modes and improving the life or propellant cooled antifriction bearings are needed for reusable rocket engines.

Contact:
G. Young
(205) 544-7070

Test Division — Activities include experimental research and development testing of propulsion systems, subsystems, and components for space systems hardware. Current specific areas of interest relate to automated test control systems. A continuing interest exists for new and advanced instrumentation techniques.

Contact:
R.L. Thompson
(205) 544-1247

Propulsion and Motor Systems Division — Research and development is ongoing in liquid rocket engines, solid motors, propulsion systems, and reaction control systems. There is continuing interest in solid and liquid propellant combustion, performance prediction, engine risk management, launch and space vehicle propellant and pressurization systems, hybrid boosters, and advanced engine health monitoring subsystems. Special emphasis area is zero- and low-gravity propellant systems and combustion.

Contact:
L. Jones
(205) 544-7094

C. Verschoore
(205) 544-6996

Space Sciences Laboratory

Tropospheric Wind Profiling — Wind profiles to heights of 18 km and estimates of wind variability are critical inputs for launch vehicle design and actual launch decisions. To optimize vehicle performance, high temporal and spatial resolution is required for wind profile measurements. Currently NASA uses Jimsphere balloons and a 50-MHz radar wind profiler for wind profile measurements. Measured profiles are analyzed to produce a representative climatology and to study relationships between wind magnitudes, vertical shears, and spatial and temporal wind variability.

Contact:
S. Smith
(205) 544-5971

Stratospheric and Mesospheric Studies — Middle atmospheric (50-100 Km) density must be accurately described to permit safe re-entry and space maneuvers, satellite, rocket, balloon, lidar, radar, and nightglow measurements are being assembled into a self-consistent dynamical atmospheric model. All scales of motion from seasonal to planetary waves to tides to gravity waves are important to vehicle

and trajectory designers. Theoretical and empirical research efforts are examining such atmospheric waves and their interactions.

Contact:
S. Smith
(205) 544-5971

Model Studies of Storm Electrical Processes — This research estimates the Maxwell current between discharges and the Wilson conduction current. The Maxwell current was found to vary linearly with total flash rate. The Wilson conduction current tended to level off with increasing flash rate. Recent efforts to gain a better understanding by modeling U-2 observations provided extremely encouraging results. The modeling should now be extended to study more quantitatively the relationship between lightning rates and characteristics (e.g., charge transfers, percentage of cloud-to-ground, etc.) and the resultant currents.

Contact:
R. Blakeslee
(205) 544-1652

Cloud Scattering of Lightning Discharges — This task is to model the radiation viewed from space resulting from lightning discharges within clouds. The solution is given in terms of scattering amplitudes that take into account the propagation parameters of air, water, and ice. Reciprocity relations for the scattering cross sections correspond to an arbitrary direction of the incident wave. The interest of this work is in determining the relationship between cloud physics parameters, lightning discharges, and the remotely sensed signal to be viewed from space.

Contact:
W. Koshak
(205) 544-8749

Atmospheric Electricity — Research is directed toward understanding the physical processed leading to the generation of electrical energy within thunderstorms and culminating in lightning. Modeling, analytical and, observational approaches are used in these studies. Particular emphasis is on the measurement of lightning activity with ground, air, and space based sensors. An important aspect is the development of advanced space-based optical sensors to study the distribution and variability of global lightning activity.

Contact:
H. Christian
(205) 544-1649

Aerosol Backscatter Studies — This research assesses global patterns of aerosol backscatter for accurate remote sensing of tropospheric wind profiles from a space-based lidar (laser radar). Major experimental efforts include a network of CO_2 lidar stations, intensive field campaigns in remote locations, satellite-based aerosol measurements, and other various aerosol sensors. These datasets have been compiled in a centralized database and detailed intercomparisons of the datasets are being performed. Correlations of meteorological variables with aerosol backscatter are examined. Physical, chemical, and optical properties are modeled for major aerosol types to enable estimation of aerosol backscatter at any wavelength. Results are being combined in a preliminary global-scale empirical model of aerosol backscatter at prospective space-based lidar wavelengths.

Contact:
M. Jarzembski
(205) 544-0240

Infrared Remote Sensing of Atmospheric Water Vapor — This research is aimed at retrieving estimates of total column atmospheric water vapor using satellite and aircraft observations in two channels in the infrared part of the electromagnetic spectrum. Observations in these channels are used in a physical procedure which relates a first guess estimate of integrated water content (IWC) (or precipitable water) and the observed brightness temperatures to produce an estimate of the observed IWC. The derived IWC can be related to cloud and storm formation as well as a climatology if derived at large space and time scales.

Contact:
A. Guillory
(205) 544-6462

Microwave Measurement Studies — Acquisition and analysis of satellite and aircraft passive microwave radiometer measurements lead to further understanding of the microphysical processes of precipitation systems and aid in monitoring climate change. Measurements from Advanced Microwave Precipitation Radiometer contain information about the spatial and temporal structure of tropical precipitation systems, and improved inversion techniques will lead to increased understanding of the heating profile in tropical atmospheres. Satellite measurements provide a global measure of atmospheric temperature and precipitation. Analysts use our multi-year temperature and precipitation datasets to monitor the atmosphere and identify and categorize any long term climate changes. Key future research will be methodology to retrieve other physical parameters from the satellite measurements.

Contact:
V. Griffin
(205) 544-8293

Climate Modeling — This research effort is geared toward understanding the sensitivity of the climate model to surface boundary forcing, i.e., sea surface temperature, albedo and soil moisture anomalies. Several experiments with different forcing will be compared to the control run climate. Extensive CRAY usage (approximately 100 CPU hours) will be required. Comparison of results to observed atmospheric behavior will be carried out eventually using MSU, OLS, and AVHRR satellite data.

Contact:
D. Fitzgarrald
(205) 544-1651

Physical Climate Analysis — Observational, numerical modeling , and analytical approaches are used to study the Earth's physical climate system. Diagnostic analysis of space-based observations are used to understand and validate models of global hydrologic cycle. Numerical models ranging in scope from the atmospheric general circulation codes to mesoscale and cloud models are used to test models of the water cycle and its role in climate. Simulations of remote sensors are used to understand how space-based observations can best study the Earth as a system.

Contact:
F. Robertson
(205) 544-1655

Geophysical Fluid Dynamics and Modeling — The functional fluid dynamics of the Earth are not well understood. Research is underway to develop and use models to understand the system, including laboratory models, numerical models, and more detailed numerical models of the atmosphere and its interaction with the underlying surface. The results from these modeling efforts will be used to guide the development of more sophisticated models of the geophysical system, as well as the development of sensors.

Contact:
T. Miller
(205) 544-1641

Space Vehicle Environments — Research activities are underway to improve knowledge of the natural space environment to support engineering of advanced NASA missions. Emphasis is on study of density, composition, and temporal variation of the Earth's thermosphere and mesosphere, and the Martian atmosphere. The objective is to improve knowledge and environmental models which impact the design of re-boost, guidance navigation and control systems for orbiting vehicles, or which influence on-orbit safety factors.

Contact:
J. Anderson
(205) 544-1661

Surface Properties/Atmospheric Boundaries Interactions — Research activities undertaken will emphasize interactions between unconsolidated sediments on the surface and atmospheric processes in the boundary layer on a local and regional basis and all time scales. Mass and energy transport phenomena will be studied. Comparison with hydrologic models will be made for the conditions studied. The results of such comparisons will be verified by appropriate sensors from laboratory experimental investigations, field ground-based stations, and remote sensors.

Contact:
N. Costes
(205) 544-1637

Atmosphere/Land Surface Interface — Earth's surface geophysical properties, and their linkages to the atmosphere and hydrologic cycles are being modeled using remotely sensed data. Measurements from satellite and aircraft sensors are utilized to study spatial and spectral resolution and temporal variability effects on the determination of land surface temperatures and energy fluxes and vegetation indices. The influence of vegetation type and structure on these properties is examined from several ecosystem types.

Contact:
T. Miller
(205) 544-1641

Space Plasma and Upper Atmospheric Physics — We seek to better understand, and ultimately to predict, the flow of matter, momentum and energy through the region in which the Sun-Earth connection is made: the Earth's magnetosphere and ionosphere. We further seek to better understand basic physical processes that effect the operation of spacecraft in space and that are important in astrophysical plasmas; for example cometary, planetary, and stellar upper atmospheres. Plasma and gas dynamic processes are studied by means of in situ plasma and neutral particle measurements, and by remote optical and electromagnetic sensing of the constituent plasmas and gases. Activities include design, development, and calibration of flight instrumentation, with analysis and interpretation of the resulting data in terms of physical models.

Contact:
T. Moore
(205) 544-7633

Solar Physics — The influence of the magnetic field on the development and evolution of solar atmospheric structure is studied. The primary data are vector magnetograms obtained at Marshall's Solar Observatory. These observations are complemented by theoretical studies to characterize the nonpotential opportunities of these fields. This includes the development of MHD (magnetohydrodynamic) codes designed to simulate both coronal and large scale interplanetary dynamic. Instrument development programs in optical polarimetry, grazing, and normal incidence X-ray optics, and imaging detectors are being pursued.

Contact:
J. Davis
(205) 544-7600

X-ray Astronomy — Theoretical and experimental research is conducted in the fields of X-ray astronomy and high-energy astrophysics. Specialists include study of neutron stars, active galactic nuclei, and imaging X-ray detectors operating from 1/4 KeV to 100 KeV. Opportunities include participating in balloon flights of these detectors, theoretical studies of physical processes near compact objects, and analysis of data from the Einstein (HEAO-2) and EXOSAT satellites.

Contact:
M. Weisskopf
(205) 544-7740

Gamma Ray Astronomy — Gamma ray astronomy is performed with balloon-borne and orbiting instruments designed and developed at MSFC. The research includes experiments covering the 30 KeV to 10 MeV region to study gamma ray bursts and other transients sources, pulsars, and to study the variability and spectra of known sources. Present activities include analysis of data from the Burst and Transient Source Experiment on the Gamma Ray Observatory, and the development of new balloon-borne instruments. A study of the gamma ray background in the atmosphere and on spacecraft is in progress with calculations and with measurements on Spacelab, LDEF, and GRO.

Contact:
G. Fishman
(205) 544-7691

Cosmic Ray Research — Cosmic ray research at MSFC emphasizes the study of the chemical composition and energy spectra of cosmic ray nuclei above 105 GeV. Study of the interactions of heavy cosmic ray nuclei is also carried out to determine the behavior of nucleus interactions and to search for evidence of new states of nuclear matter. The research is carried out principally with emulsion chambers, and with electronic counters, exposed on balloons at about 40-kilometers for up to two weeks. Research includes laboratory work data analysis, particle cascade calculations, and correlative accelerator experiments.

Contact:
T. Parnell
(205) 544-7690

Infrared Astronomy — Astronomical research is carried out in close coordination with the development of IR sensors. The sensors, which span the spectral region between 1 and 30 micrometers, are used at major telescopes to produce unique images of comets and regions of star formation in our own and other galaxies. These data provide clues to cometary structure, origin, and long-term evolution.

Contact:
C. Telesco
(205) 544-7723

Cryogenic Physics — Research is conducted on cooled sensors for advanced space science experiments and cooling systems to support the sensors. Stored cryogens are developed, as well as active refrigeration systems extending both to sub-Kelvin temperatures needed by infrared bolometers and conventional superconducting electronic devices, and to higher operating temperatures required by high critical temperature superconducting electronic devices. Sensor research includes conventional and superconducting infrared detectors and arrays. Well-equipped laboratories exist to support research on improved superconducting materials and sensors.

Contact:
E. Urban
(205) 544-7721

Microgravity Solidification — Theoretical and experimental research is conducted on the effects of gravity on the crystal growth or solidification of materials including semiconductors, metals, alloys, polymers, model systems, etc. Both the preparation and the characterization of materials are important. The areas of research include solid-state physics, surface physics, solidification phenomena, fluid modeling, analysis of crystal growth, and characterization techniques such as optical, X-ray, and electron microscopy. In addition to well-equipped laboratories for these activities, the division operates a drop tube 100 meters high.

Contact:
F. Szofran
(205) 544-7777

Biophysics — An opportunity exists to conduct research in the separation and purification of biological cells and proteins to develop a basic understanding of the separation phenomenon. The proposed research should include analysis of the fundamental behavior of a separation process by theoretical and/or experimental methods. A second activity involves laboratory and space experiments in protein crystal growth. High quality single crystals are required to obtain the three-dimensional structure of the proteins, and Shuttle space experiments confirm the advantages of the microgravity environment. Projects include experiments to define improved crystallization conditions and the analysis of crystals by X-ray diffraction.

Contact:
D. Carter
(205) 544-5492

Structures and Dynamics Laboratories

Pointing Control Systems — Tasks include pointing systems with performance of one milliarcsecond, ability to actively control structures with structural modes below the control frequency, use of fiducial light systems and unobtrusive sensors/effectors to stabilize large space structures, development of the theory of many control systems working on the same flexible structure, modeling and control of flexible multibodies with configuration changes, and momentum exchange control of very large objects, and wave front control by phases array mirrors.

Contact:
H. Waites
(205) 544-1441

Control of Space Vehicles and Robotic Manipulators — Tasks include development of autonomous adaptive control algorithms for reusable launch vehicles and spacecraft during all flight phases included rendezvous, docking, re-entry, and landing. Image processing/pattern recognition algorithms for target spacecraft identification and attitude determination (both stabilized and tumbling). Control systems for tethered spacecraft, spacecraft control system health monitoring, and adaptive control of flexible robotic manipulators.

Contact:
N. Hendrix
(205) 544-1451

Liquid Propulsion Dynamic Analysis — Task include dynamic analysis, determination of damping methods, analysis of bearings, and dynamic balancing of high-speed turbomachinery. Topics of interest in control include rapid recognition of engine failure, detecting incipient failure, automatic reconfiguration of control components, and more accurate means to control propellant mixture ratio.

Contact:
P. Vallely
(205) 544-1440

Structural Dynamics — Activities of interest are aerostructural modeling, vibration analysis, and load predictions using simulation of all environments, including propulsion, control, aerodynamics, and atmosphere. Probabilistic, as well as deterministic, approaches are used on the CRAY to simulate flight and obtain loads data. Enhanced dynamic analysis techniques are pursued.

Contact:
W. Holland
(205) 544-1495

Structural Assessment: Structural Analysis — Opportunities exist for research in strength, stability, fatigue, and fracture mechanics analyses. Extensive use is made of computationally intensive methods such as finite and boundary element analyses. Practical enhancement methods are sought such as solution adaptive finite element modeling techniques. Technology improvement in analysis and computational methods which lead to development of practical engineering tools are encouraged. The CRAY computer is available for analytical analysis in conjunction with work stations.

Contact:
C. Bianca
(205) 544-7182

Vibroacoustics — Mechanically and acoustically induced random vibration design and test criteria and response loads analytically derived using advanced computer techniques. Vibration, acoustic, and transient data from engine static firing and Space Shuttle flights are analyzed and categorized. Research opportunities include improved vibroacoustic environment prediction methods and high frequency vibration data analysis techniques.

Contact:
J. McBride
(205) 544-1523

Structural Design Optimization/ Synthesis — In view of the need for lighter, stiffer, and stronger launch and space vehicle structures, new ways of designing structural systems are being sought. Research is needed in the area of vehicle synthesis which includes the synergistic effects of assembly of structurally optimized elements and components. Efficient and effective design methods and tools using numerical optimization, trajectory analysis, thermal analysis, loads, stress, environments, and other critical criteria are needed.

Contact:
P. Rodriguez
(205) 544-7006

Thermal Analysis: Liquid Propulsion Systems — Opportunities for research exist in thermal analysis of liquid propulsion system components, including integrated thermal/structural analysis of turbine section and rotating components in high-pressure trubomachinery. Analytical results may be correlated to ground test data.

Contact:
J. Owen
(205) 544-7213

Thermal Analysis: Solid Rocket Motor — Opportunities are available for research in thermal modeling and analysis of solid rocket motor thermal protection systems. Specific areas include the modeling of ablation processes involving a variety of material surfaces and the determination of heat transfer coefficients in radiative, erosive, and chemically reactive environments.

Contact:
K. McCoy
(205) 544-7211

Thermal/Environmental Computational Analysis — Research opportunities are available in advanced thermal modeling and analysis techniques based on state-of-the-art graphics systems and software. Research is needed in methods of 3-D graphic modeling of thermal systems which are compatible with computational fluid dynamics and stress modeling.

Contact:
G. Schunk
(205) 544-7221

Hypervelocity Impact Design and Analysis — Research opportunities are available in the design, analysis, and testing of advance hypervelocity impact shields. Due to the increased space debris, more weight-efficient shields are needed for all future long-term space endeavors. Specific areas include ballistic limit predictions, impact and penetration effects, innovative shield designs for minimum maintenance, quick deployment/ retraction shields, composite material shield design, novel shields, and damage prediction.

Contact:
J. Robinson
(205) 544-7013

Computational Fluid Dynamics — Opportunities to develop and apply state-of-the-art computational fluid dynamic (CFD) methods to solve three-dimensional highly turbulent flows for compressible and incompressible, and reacting fluid states, and to provide benchmark CFD comparisons to establish code quality for subsequent application. Research is needed to assess significant aspects of the computational algorithms, grid generation, chemistry and turbulence modeling code efficiency, and stability, etc.

Contact:
P. McConnaughey
(205) 544-1599

Systems Analysis and Integration Laboatories

Configuration Management — Configuration management is an essential component of any successful engineering activity. Marshall projects tend to be both large and complex, requiring the efforts of teams of both NASA and contractor engineers. The level of control required by manned space flight makes configuration management a critical activity. Automated tools and improved methods are continually sought.

Contact:
N. Foster
(205) 544-2425

Systems and Components Test and Simulation — Opportunities exist for the development, qualification, integration, and flight acceptance testing of space vehicles, payloads, and experiments. Neutral buoyancy simulations for training and development of extravehicular activity (EVA) techniques are performed. Thermal vacuum testing is conducted in a variety of chambers with capabilities to 1X10-7 torr and temperature ranges from 149C to +204C. Facilities exist to calibrate X-ray payloads and scientific instruments utilizing a 518-meter evacuated guide tube.

Contact:
G. Hartsfield
(205) 544-6965

R. Stephens
(205) 544-1336

C. Reily
(205) 544-1298

Crystal Growth in Fluid Field and Particle Dynamic Evaluation — The Fluid Experiment System (FES) was developed to study low-temperature crystal growth of a triglycine sulfate solution in a low-gravity environment. Incorporated into the FES is a laser/optical system for taking holograms of crystal growth, fluid density, and temperature variations. Tasks include applying holographic and digitized image techniques to evaluating these holograms.

Contact:
J. Lindsey
(205) 544-1301

Missions Operation Laboratory

Flight Operations — The Mission Operations Laboratory performs functions contributing to the performance of science in space, particularly focusing on development of space science operations capabilities. Payload operations are integrated premission and managed during the on-orbit execution in support of the science users. The operations control function includes command planning, control plans and procedures, and air-to-ground voice management. The data management function includes end-to-end flow analysis and management, requirements development for flight systems, and intercenter data requirements development. The mission planning function includes orbit analysis, mission timelining, flight design, and development of planning systems.

Contact:
C. Owen
(205) 544-2017

Training/Training Systems — Training on payload operations is provided for the payload crew, payload flight controllers, and investigators using computer simulations, computer-aided training, mock-ups and/or engineering models. Continuous improvement requires that training methods and tools be assessed and updated on a periodic basis. These updates are based on improved capabilities/technology, current information relative to pedagogy, and lessons learned from previous training sessions.

Contact:
D. Underwood
(205) 544-2191

Gloria Hullett-Smith
(205) 544-2050

Ground Support Systems — The Huntsville Operations Support Center is the ground facility that supports multi-project flight operations. The design and development function includes communications (voice, video, wideband data handling, and external information transfer), data acquisition and processing, payload and spacecraft commanding user work station data presentation, and facility support functions. Development includes prototyping new technologies to insure state-of-the-art capabilities, with special emphasis on remote operations linking multiple ground facilities. The facility is managed and operation in support of project and user requirements.

Contact:
K. Cornett
(205) 544-2025

Human Factors — Human factors analysis in support of flight and ground system development is performed using analytical tools as well as mockups in both 1-G and neutral buoyancy zero-G simulations. Human computer interface standards are developed and applied to flight crew tasks and evaluation of control and display devices. New, more effective man/machine interface techniques are evaluated and integrated into design and operational activities.

Contact:
S. Hall
(205) 544-0517

Expert Systems — New software methods are needed to automate and simplify increasingly complex ground support tasks associated with spacecraft and payload flight operations. Reset projects are projected in the areas of automated analysis of engineering and operations telemetry, decision support, and trend analysis.

Contact:
M. McElyea
(205) 544-2034

Safety and Mission Assurance Office

Reliability Engineering — Research and analysis are conducted to gain an understanding of complex physics of failure mechanisms with the Space Shuttle Main Engine. The use of statistical models, failure mode and effects analysis, and analysis of failure and anomaly reports, as well as applicable generic data, contribute significantly toward the research efforts.

Contact:
F. Safe
(205) 544-5278

Quality Engineering — Research is performed in areas dealing with software quality control, nondestructive evaluation (radiography, ultrasonic, eddy current), critical process control, use and evaluation of inspection methods, and assessment of critical characteristics in inspection with respect to control of critical items.

Contact:
R. Bledsoe
(205) 544-7406

R. Neuschaefer
(205) 544-7382

Systems Safety Engineering — Opportunities exist for research in the development and implementation of quantitative and qualitative techniques directed at the identification, evaluation, and control of hazards associated with complex space systems. This includes probabilistic risk assessment, fault tree analysis and applications, interactive hazard information tracking and closure systems, and the identification of conceptual approaches to establishing mission levels and requirements for various types of space missions.

Contact:
J. Livingston
(205) 544-0049

John C. Stennis Space Center

Program Administrator

Dr. Armond T. Joyce
University Affairs Officer
John C. Stennis Space Center
Science and Technolgy Laboratory
Stennis Space Center, MS 39529
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NASA's John C. Stennis Space Center (SSC), located near Bay St. Louis, MS, has grown into NASA's premier center for testing large rocket propulsion systems for the Space Shuttle and future generations of space vehicles.

Stennis Space Center's primary mission is to support the development and testing of large propulsion systems. Static testing is conducted on the same huge concrete and steel towers used from 1966 to 1970 to captive-fire all first and second stages of the Saturn V rocket used in the Apollo manned lunar landing and Skylab programs. Since 1975, the Center has been responsible for flight acceptance testing on the Space Shuttle's main engines. The data accumulated from these ground tests, which simulate flight profiles, are analyzed to ensure that engine performance is acceptable and that the required thrust will be delivered in the critical ascent phase of Shuttle flights. No Shuttle main engine can fly before it is tested at Stennis Space Center. The goal of the R&D program conducted in conjunction with the test program is to significantly advance propulsion test technologies for both Government and commercial propulsion programs. The other major SSC mission is to conduct technology utilization, applications, and commercialization programs relative to environmental systems, Earth observation through remote sensing, and image processing/analysis systems.

Technology

Propulsion System Testing Techniques, Simulation, Modeling, and Methodologies —Research opportunities exist to develop new, innovative techniques to conduct the wide variety of required tests for space systems, stages/vehicles, subsystems and components. Computational Fluid Dynamics modeling and actual hardware testing might be better coupled or integrated. A flexible, dynamic fluid flow simulation and structural modeling graphic interface research tool is desirable for ground test programs of space propulsion systems. Technology development is needed for inexpensive ultra-high power pump drivers and prime movers and low operational cost.

Contact:
Bill St. Cyr
(601) 688-1134

Cryogenic Instrumentation and Cryogenic, High Pressure, and Ultrahigh Pressure Fluid Systems — Over 40 tons of liquefied gases are used annually in the conduct of propulsion system testing at the Center. Instrumentation is needed to precisely measure mass flow of cryogens starting at very low flow rates up to very high flow rates at pressures to 15,000 psia. Research, technology, and development opportunities exist in developing instruments to measure fluid properties at cryogenic conditions during ground testing of space propulsion systems. Both intrusive and non-intrusive sensors, but especially non-intrusive sensors, are desired.

Contact:
Don Chenevert
(601) 688-3126

Non-Destructive Test and Evaluation — Advanced instrumentation, methods, and techniques to conduct advanced non-destructive test and evaluation, failure analysis, and purity and cleanliness assessment are desired. The object of non-destructive test and evaluation would range from entire propulsion systems down to the component level. One unique application of non-destructive test and evaluation would be on especially thick walled high pressure ground test facilities vessels and areas not readily accessible to personnel. Research opportunities exist in acoustic emission, ultrasonics, high energy radiography in the non-destructive test and evaluation laboratory.

Contact:
Bill St. Cyr
(601) 688-1134

Vehicle Health Management/Rocket Exhaust Plume Diagnostics — A large body of UV-Visible emission spectrometry experimentation is being conducted during the 80 or more tests each year of the Space Shuttle Main Engine at SSC. Research opportunities are available to quantify failure and wear mechanisms and related plume code validation. Related topics include combustion stability and mixture ratio and thrust/power level. Vehicle health management/exhaust plume diagnostics experimentation may be readily conducted at the SSC Diagnostics Testbed Facility. Currently, some exploratory studies have been done with emission/absorption spectroscopy, absorption resonance spectroscopy, and laser induced fluorescence.

Contact:
Gerry Meeks
(601) 688-1935

Spectroscopy Technology for Propulsion System Testing — Numerous opportunities exist to advance spectroscopy technology for propulsion system testing. Only a relatively small portion of the electromagnetic spectrum has been investigated for use in propulsion system testing and exhaust plume diagnostics/vehicle health management.

Contact:
Chuck Thurman
(601) 688-1023

Active and Passive Non-Intrusive Remote Sensing of Propulsion Test Parameters — The vast amount of propulsion system test data is collected via single channel, contact, intrusive sensors and instrumentation. Future propulsion system test techniques could employ passive non-intrusive remote sensors and active non-intrusive remote sensing test measurements over wide areas instead of at a few discrete points. Opportunities exist in temperature, pressure, stress, strain, position, vibration, shock, impact, and many other measured test parameters. The use of thermal infrared, ultraviolet, and multi-spectral sensors, imagers, and instruments is possible through the SSC sensor laboratory.

Contact:
Heidi Barnes
(601) 688-1843

Environmental Impact from Propulsion System Testing — The testing of advanced and current propulsion systems, may result in impact to the environment. The current plume control technology includes plume deflectors and meteorological prediction. The needed research and technology development would address the impacts, modeling, impact measurement or quantification, and prevention, reduction, or mitigation. The research may also indicate the need for exhaust plume scrubbers or other abatement devices, facilities, equipment, or instrumentation.

Contact:
Bill St. Cyr
(601) 688-1134

Ground Test Facilities Technology — Ground test facilities seldom keep pace with propulsion system development programs partly because the facility is usually designed before the test requirements are known and because test facilities are usually extant and inflexible. An innovative approach to producing flexible, easily adaptable ground test facilities is highly desirable. Research opportuni-

ties are available at the Diagnostics Testbed Facility to develop ground test facilities technology.

Contact:
Don Chenevert
(601) 688-3126

LOX/GOX Compatible Materials— Liquid Oxygen (LOX) and Gaseous Oxygen (GOX) is a prime oxidizer for liquid fueled rocket engines and represents a dangerous material to handle. There exists a major need for a group of LOX/GOX compatible materials for seats, seals, and solid lubricants for valve and pump components and other uses. Simple, effective, safe techniques to easily and cheaply test or qualify new LOX/GOX compatible materials is desirable.

Contact:
Bill St. Cyr
(601) 688-1134

Thermal Protection and Insulation Systems — The test of liquid rocket systems employ very large flame buckets and diffusers to control, deflect, cool, condition, and reduce the sound level of the plume. Innovative thermal protection tiles, coating, or materials, and insulation systems could result in significant savings. Cryogenic lines and vessels typically require expensive vacuum jackets, expansion joints, and devices to maintain the fluids at the required extremely cold and some time high pressure conditions. Cheaper, better, or newer thermal protection and insulation systems might do the same tasks cheaper and require little or no maintenance.

Contact:
Bill St. Cyr
(601) 688-1134

Material and Fluid Science — In some cases the basic physics of the material, heat transfer, thermal or fluid science is not understood well enough to model the propulsion system test facility to the required level of sophistication. As more advanced systems are developed, fundamental data is needed to properly design the test facilities. Characterization of collapse factor at pressurant and cryogenic fluid interface, cavitation, and thermal stratification are areas of interest. Particular attention is needed to develop materials for LOX service at extreme pressures and to resist hydrogen embrittlement. Research opportunities are available at the 210,000 gallon liquid hydrogen barges, High Pressure Gas Facility, Gas and Materials Analysis Laboratory, the Advanced Sensor Development Laboratory, the Diagnostics Testbed Facility and a planned Cryogenic Conditions Testbed.

Contact:
Bill St. Cyr
(601) 688-1134

Propellant and Pressurants Conservation, Recycling, and Energy Conservation — Large quantities of cryogenic fluids are used to bring propulsion systems and the test facility complexes from ambient temperatures to several hundred degrees Fahrenheit below zero. This chilldown represents a high loss of energy that cost millions of dollars. Research into operations techniques, recovery facilities and equipment, and energy management and conservation could likely improve ground testing, to save money and energy.

Contact:
Don Chenevert
(601) 688-3126

Leak Detection, Sensors, Quantification, and Visualization — Opportunities exist in leak detection technology to determine what is leaking, how much is leaking, where is the source of the leak, and how to model and visualize the extent of the effected area. Often hydrogen leaks are the topic of concern because of the explosive nature of hydrogen, and the expense for repairing the leak when eventually found. However, other hazardous and non-hazardous fluid leaks are also of concern. Leaks occur usually in accessible compartments and locations and may occur in inert gas backgrounds as well as in atmospheres where oxygen is present. Leak pinpointing techniques that may not employ instrumentation are of interest.

Contact:
Gerry Meeks
(601) 688-1935

Advanced Propulsion Systems Testing— Innovative techniques will be required to test propulsion systems such as advanced chemical engines, single-stage-to-orbit rocket plane components, nuclear thermal and nuclear electric rockets and hybrids rockets. With a shrinking budget and longer leadtimes to develop new propulsion systems, new approaches must be developed to test future propulsion systems. The solution may be some combination of computational-analytical technique, advanced sensors and instrumentation, and predictive methodologies.

Contact:
Don Chenevert
(601) 688-3126

Information Systems

Computational Modeling and Simulation — The Information Systems Division has an effort to assess modeling software tools that can support science and engineering users in developing, using and exercising large scale models in supercomputing applications, with specific emphasis on applicability to propulsion testing requirements. The research will include a classification of the various models which can support propulsion test and further justify how these models would apply to specific propulsion test tasks and activities. The research will also define and document a detailed procedure and process for using a supercomputer at SSC.

Contact:
Kirk Sharp
(601) 688-3586

Artificial Intelligence (AI) Capability for Intelligent Processing of Remotely Sensed and Propulsion Test Data — Artificial Intelligence techniques and concepts are being investigated to determined which can be used to collect, organize, and retrieve the vast amounts of data produced by NASA missions. This research will focus on investigating the use of AI expert system technology in the classification of remotely sensed spatial data and extraction of information from propulsion test data. This effort will result in a survey and evaluation of expert system shells, a survey and evaluation of AI tool boxes for uncovering relationships in data, and porting a satellite image classification methodology written in the AI language PROLOG and C onto an IBM computer.

Contact:
Kirk Sharp
(601) 688-3586

Use of Visualization Technologies for SSC Data Analysis — This research will consist of a review current visualization software packages (i.e. AVS) and identifying the feasibility of using these for developing interface and file format standards for use across SSC programs in order to share resources, data, techniques and technologies. Various SSC programs/activities such as CTF, NLS/ALS, center archival, and propulsion testing require a "visualization" function for data analysis and display. A feasibility demonstration will be developed using an actual application, thus allowing the visualization technology to be used across multiple SSC programs.

Contact:
Kirk Sharp
(601) 688-3586

Application of Parallel Computing to Data Analysis — The purpose of this research is to obtain a firm understanding of how this potentially radical technology can be applied to several NASA applications. This effort will result in an examination of the commercially available options, the nature of the algorithms currently employed, and the existing facilities. Based on the results, a proto-type or demonstration system will be built.

Contact:
Kirk Sharp
(601) 688-3586

Visual Data Analysis — Opportunities exist for the development and enhancement of software tools to support the visualization of propulsion test data. Incorporate the use of artificial intelligence to develop automated and semi-automated methods of data interpretation. Incorporate modeling techniques to allow the investigator to explore a variety of "what if" situations.

Contact:
Kirk Sharp
(601) 688-3586

Propulsion Test Data Acquisition Systems — Investigations into the integration of real-time propulsion test systems are needed. Specifically, how can large amounts of data from sensor channels and control systems be optimally managed? Research is needed into optimum data channel bandwidth, the appropriate separation of control and data systems, and how the data and control systems can exchange data given the separation.

Contact:
Kirk Sharp
(601) 688-3586

Data Archive — The Information Systems Division has the role of data archiving for a variety of scientific data acquired from satellites, airborne scanners, medical sensors, and propulsion test instruments. This research will review data archive requirements at SSC and investigate current data archive technology. The results of the research will be recommendations of hardware, software, and methodology for performing the data archive function as required by the ISD.

Contact:
Kirk Sharp
(601) 688-3586

Image Compression — This research will involve an investigation into current technology for performing image compression on both static and animated imagery. Applications will be for a broad range of data utilized at SSC including satellite, airborne scanner, video, medical, and multimedia. Focus will be on the reduction of physical media required for storage as well as reduction of time for network transmission of data. Issues will include compression ratios, data fidelity, and speed of compression/decompression algorithms. A recommendation and demonstration of a compression technique for each of the imagery types included in the study will be required.

Contact:
Kirk Sharp
(601) 688-3586

Earth Observations Research

Remote Sensing and Plant Physiological Ecology — The detection of plant radiative responses to growth conditions remains as a major goal in remote sensing research. This is true particularly with respect to early detection of plant stress. We are interested in the continued study of leaf and canopy reflectance responses to various stress agents, and the development of techniques to enable the earliest possible detection of stress. This has involved the identification of narrow spectral bands in which reflectance is most strongly affected by various stress agents. We also are continually interested in basic influences on leaf radiative properties, and their relationships to leaf chemical content and physiological processes, particularly photosynthesis.

Contact:
Gregory A. Carter
(601) 688-1918

Forest Ecology — A number of study plots have been selected which are representative of the major forest ecosystems found today on the Gulf Coastal Plain. In addition, both satellite and aircraft remote sensing data have been acquired over these sites. Proposed research may be in any area of forest ecology, but it is desirable that remote sensing may be an ancillary tool of analysis. It is also desirable that portions of the investigations consider below ground processes and the manner in which these affect above ground processes. (Also see below).

Contact:
Bill Cibula
(601) 688-1913

Forest Mycosociology — The mycorrhizal association of tree roots and higher fungi is vital to tree and forest health. In Europe, the precipitous decline in the diversity of ectomycorrhizal fungal species has been postulated as a major cause of forest decline ("Waldsterben"). In southeastern forests, mycosociological data on the diversity of species, and interrelationships within various southern forest ecosystems is severely lacking. In an effort to obtain baseline data in the southern United States, plots (60m x 60m) have been established in four uniform forest ecosystems in the SSC environs. Each plot is subdivided into 400 subplots that are 3 by 3 m each. It is desirable that interested investigators consider studies that would use these already established forest study plots. In addition, both color infrared photography and digital remote sensing data exist for these plots and their environs.

Contact:
Bill Cibula
(601) 688-1913

Leaf Reflectance Anomaly in *Pinus* — In color infrared photography (CIR), canopies of loblolly pine (*Pinus taeda*) are typically much darker and a more muted red than canopies of slash (*Pinus elliottii*) or longleaf (*Pinus palustris*) pines. This is explained by substantially lower leaf reflectances within the 760 nm to 1080 nm wavelength range in loblolly pine compared with slash and longleaf pines. However, the physical/chemical basis for this difference among species is not known. An investigation of this phenomenon would contribute substantially to our understanding of leaf/canopy biophysics in pine forests of the southeastern U.S.

Contact:
Bill Cibula
(601) 688-1913

Coastal Processes — Focuses on interdisciplinary research related to biogeochemical cycles (biological - physical interactions) and coupling between land and ocean processes. Work includes algorithm development and image processing across multiple computer platforms.

Contact:
Richard Miller
(601) 688-1904

Research Software — Emphasis on developing efficient software for the analysis and visualization of **in situ** and remotely sensed data for earth science research. Focus on low-cost computer platforms.

Contact:
Richard Miller
(601) 688-1904

Archeological/Anthropological Predictive Modeling — Remotely sensed satellite and airborne data can be used to detect anomalies in the surface cover that are representative of prehistoric cultural remains. Sophisticated computer-analysis techniques have been developed to extract archeological/anthropological phenomena from the nonvisible portion of the electromagnetic spectrum. By combining remotely sensed and ancillary information into a data base, accurate predictive models can be developed to isolate potential locations of prehistoric activity. Various cultures representing diverse environmental conditions are being examined to determine the spectral and spatial characteristics required for archeological/anthropological features detection.

Contact:
Tom Sever
(601) 688-1906

Commercialization

Commercial Remote Sensing — The Commercial Remote Sensing Program is designed to establish U.S. preeminence in value-added information products derived from remote sensing and related information technologies. The program is accomplished by conducting collaboration research in application and advanced technology development projects with private firms, universities, and government agencies focused on the following areas: 1) satellite data acquisition, 2) data analysis/product generation, and 3) information distribution and product delivery.

Contact:
Chuck Hill
(601) 688-2042

Section III

1995 NASA Graduate Student Researchers Program

Underrepresented Minority and Disabled Focus Component

Summary and Objectives

NASA has a rich history of working with minority-serving institutions and with underrepresented minority and disabled faculty and students. In this program, we strive to build upon these relationships to increase diversity among this nation's scientists and engineers. Students selected for this program will collaborate with faculty advisors and with NASA technical officers at Headquarters or at one of the NASA field centers. Students are encouraged to contact the appropriate facility technical advisor to coordinate research activities.

The program offers:

- *up to $22,000 per year of support for a total of up to three years;*
- *first hand exposure to NASA research;*
- *the opportunity to work at national laboratories with unique facilities;*
- *the chance to interact with the nation's top aerospace engineers and scientists.*

Awards are initially made for a one-year period and may be renewed annually, for up to three years.

Eligibility — Because Blacks, Hispanics, American Indians, Pacific Islanders (having origins in any of the original peoples of Hawaii; the U.S. Pacific Territories of Guam, American Samoa, and the Northern Marianas; the U.S. Trust Territory of Palau; the Islands of Micronesia and Melanesia; and the Philippines), and individuals with a disability that limits a major life activity have been underrepresented in science and engineering, they are the focus of this special effort. Applicants must be:

- enrolled in a full-time graduate program at an accredited U.S. college or university;
- studying engineering, physics, mathematics, computer science, biology, aeronautics, space sciences, life sciences, or another discipline of interest to NASA;
- highly motivated to pursue their plans of study in NASA related research;
- U.S. citizens.

Please note that identification of one's disability is required, and proof of tribal affiliation for Native Americans is requested.

Students may enter the program at the beginning of a master of science or a Ph.D. program. Students may apply prior to receiving their baccalaureate degrees. An application must be sponsored by the student's graduate department chair or faculty advisor. Those selected will usually receive support until they obtain an advanced degree, a maximum of three years in most cases. Individuals accepting this award may not concurrently hold another Federal fellowship or traineeship. Students who apply to this program are also eligible for the Graduate Student Researchers Program.

Selection of Proposals — Proposals will be evaluated in two categories: M.S. and Ph.D. Graduate students will be selected on the basis of their academic qualifications; the quality of their plan of study or proposed research and its relevance to NASA's research interests and needs; if applicable, the student's utilization of research facilities at the NASA centers; and to maintain appropriate balance between male and female applicants.

Multiple Submissions — When submitting to more than one NASA facility or to both the Underrepresented Minority and Disabled Focus (UMDF) Program and the Graduate Student Researchers Program (GSRP), separate original application forms and all required information, including the number of copies necessary to evaluate the proposal, must accompany each submission.

Application Procedure — All applicants must submit one original and nine (9) copies of all materials by February 1 of each year to the appropriate NASA facility, addressed to the attention of the Underrepresented Minority and Disabled Focus Program Administrator listed on page 95.

For detailed instructions on administrative procedures and proposal format for the Underrpresented Minority and Disabled Focus Component see pages 10-13.

Underrepresented Minority and Disabled Focus Program Administrators

Ms. Deborah Russell
Education Services Specialist
Code EU
NASA Headquarters
Washington, DC 20546
Phone (202) 358-0935
FAX (202) 358-3745

Mr. Aaron Hatch
Mail Stop 204-2
Ames Research Center
National Aeronautics and Space Administration
Moffett Field, CA 94035
Phone (415) 604-0790
FAX (415) 604-3953

Ms. Erma Cox
P.O. Box 273
Hugh L. Dryden Flight Research Center
Edwards AFB, CA 93523
Phone (805) 258-3033
FAX (805) 258-3567

Dr. Gerald Soffen
Code 160
Goddard Space Flight Center
National Aeronautics and Space Administration
Greenbelt, MD 20771
Phone (301) 286-9690
FAX (301) 286-1610

Mr. Alfred Paiz
Mail Stop 238-420
Jet Propulsion Laboratory
National Aeronautics and Space Administration
4800 Oak Grove Drive
Pasadena, CA 91109
Phone (818) 354-3014
FAX (818) 393-4977

Dr. Joseph D. Atkinson
Mail Code AJ111
Lyndon B. Johnson Space Center
National Aeronautics and Space Administration
Houston, TX 77058
Phone (713) 483-4831
FAX (713) 483-0609

Mr. J. Albert Diggs
Mail Code EO
John F. Kennedy Space Center
National Aeronautics and Space Administration
Kennedy Space Center, FL 32899
Phone (407) 867-2307
FAX (407) 867-1066

Dr. Samuel E. Massenberg
Mail Stop 400
Langley Research Center
National Aeronautics and Space Administration
Hampton, VA 23681-0001
Phone (804) 864-5800
FAX (804) 864-6521

Ms. Jo Ann Charleston
Mail Stop 9200
Lewis Research Center
National Aeronautics and Space Administration
21000 Brookpark Road
Cleveland, OH 44135
Phone (216) 433-2957
FAX (216) 433-3344

Mr. Willie Love
Mail Stop CE01
Marshall Space Flight Center
National Aeronautics and Space Administration
MSFC, AL 35812
Phone (205) 544-0944
FAX (205) 544-2411

Dr. Armond Joyce
Mail Code MA00
John C. Stennis Space Center
National Aeronautics and Space Administration
Stennis Space Center, MS 39529-6000
Phone (601) 688-3830
FAX (601) 688-1925

Proposals Due February 1

Underrepresented Minority and Disabled Focus

I. Student Information

Name: (Mr./Ms.)

_____

Last First MI

Birth Date:_____

Birthplace:_____

Permanent Address:_____

_____

Home Phone:_____

Target Degree: ___MS ___MS/PhD (joint) ___PhD

Discipline:_____

Department:_____

School Address:_____

_____

City, State, ZIP:_____

Campus Phone:_____ Fax No.:_____

E-Mail:_____

Undergraduate GPA:_____ Out Of:_____

Discipline:_____

Graduate GPA (If Applicable):_____ Out Of:_____

Discipline:_____

II. Faculty Advisor Information

Name:_____

Department:_____

_____

University:_____

Mailing Address:_____

City, State, ZIP:_____

Campus Phone:_____

Fax Number:_____

E-Mail:_____

*Signature:*_____ *Date:*_____

III. Official Responsible for Committing Institution

Name:_____

Title:_____

University:_____

Street Address:_____

City, State, ZIP:_____

Campus Phone:_____

*Signature:*_____ *Date:*_____

I certify that I am a citizen of the United States and that I am or will be a full-time graduate student during the period covered by the attached proposal, that I am a member of one of the following underrepresented minorities, and that I have independently written this proposal.

- ☐ *Black Male*
- ☐ *Black Female*
- ☐ *Hispanic Male*
- ☐ *Hispanic Female*
- ☐ *Native American Male*
- ☐ *Native American Female*
- ☐ *Pacific Islander Male**
- ☐ *Pacific Islander Female**
- ☐ *Male with Disability***
- ☐ *Female with Disability***

* *A person having origins in any of the original peoples of Hawaii; the U.S. Pacific Territories of Guam, American Samoa, and the Northern Mariana; the U.S. Trust Territory of Paulau; the Islands of Micronesia and Melanesia; and the Phillipines*

** *A disability that limits a major life activity*

*Signature:*_____ *Date:*_____

IV. Proposal Information

Type of Proposal: ☐ (1) New ☐ (2) Second Year ☐ (3) Third Year

If Renewal, Designate Grant No.: NGT-_____ Proposed Start or Renewal Date:_____

Expected Graduation Date: _____

Proposal Title _____

_____

Time Spent at NASA Center during past year: _____ weeks _____ months

V. Submission Information

☐ Headquarters

☐ Nasa Centers

___ Ames/Dryden (ARC/DFRF)
___ Goddard (GSFC)
___ Jet Propulsion Lab (JPL)
___ Johnson (JSC)
___ Kennedy (KSC)
___ Langley (LaRC)
___ Lewis (LeRC)
___ Marshall (MSFC)
___ Stennis (SSC)

Other Facilities to which this proposal is being submitted

_____

_____

_____

Center Technical Advisor:

_____

VI. Proposal Checklist

- ☐ Original Proposal and 9 Copies
- ☐ Budget Form
- ☐ University Certifications
  - •Suspension and Debarment
  - •Drug Free Workplace
- ☐ Signed Advisor Evaluation or Letter of Recommendation
- ☐ Original Transcripts

VII. NASA Use Only

- ☐ Org/Cpys
- ☐ BdgtFrm
- ☐ UCert
- ☐ SAE
- ☐ T

Privacy Act Statement

General

Pursuant to Public Law 93-579, Privacy Act of 1974, as amended (5U.S.C.§552a), the following information is being provided to persons who are asked to provide information to obtain a NASA Graduate Student fellowship.

Authority

This information is collected under the authority of the National Aeronautics and Space Act. Publication 85-568, as amended, 42 U.S.C.§2451, et. seq.

Purpose and Uses

NASA may disclose this information to other organizations or individuals having relationships with NASA, including but not limited to academic organizations, nonprofit organizations, and other governmental agencies, as well as Congressional offices in response to an inquiry made on your behalf. Disclosure may also be made to concerned parties in the course of litigation, to law enforcement agencies, and to other Federal agencies in exchanging information pertinent to an agency decision.

NASA Graduate Student Researchers Program
Underrepresented Minority and Disabled Focus
Budget Information

I. Student Stipend (Maximum of $16,000) $_____

II. Student Allowance (Itemize if necessary)

Student Allowance $_____
(Maximum of $3,000)

III. University Allowance (Itemize if necessary)

University Allowance $_____
(Maximum of $3,000)

Total Requested $_____
(Maximum of $22,000)

Section IV

1995 NASA Graduate Student Researchers Program

High Performance Computing and Communications

High Performance Computing and Communications

In the 1995 academic year, at least five new awards will be granted as part of the Federal High Performance Computing and Communications Program (HPCC) Program. HPCC is a multiagency program designed to accelerate the development and application of high performance computing systems through an integrated program of hardware, software, and network development, as well as long-term basic research. Within the Federal program, NASA will focus on: aeronautical, Earth science, and space science applications; interagency software coordination; and the areas of basic research outlined below. For further information on specific research projects, please contact the individuals listed below.

General information on NASA's HPCC program may be obtained by writing:

Directorate for High Performance Computing and Communications
Code RC
NASA Headquarters
Washington, DC 20546-0001

Proposals for HPCC/GSRP fellowships must be sent to the centers listed and must be coordinated with the designated points of contact.

For detailed instructions on administrative procedures and proposal format for the High Performance Computing and Communications program see pages 10-13.

Contact:
Ames Research Center
Kenneth G. Stevens, Jr.
(415) 604-5949
stevens@nas.nasa.gov

HPCC/Computational Aerosciences Project — A new generation of massively parallel systems is being developed which can be used to solve computational aeroscience problems. Research of interest includes: systems software which facilitates the efficient use of parallel systems; multidiscipline computational applications for parallel systems; and computer architectural analysis of the Intel Paragon, Thinking Machines CM5, IBM SP-2, and other emerging parallel processors including clusters of workstations. In addition to the previously mentioned parallel processors, Ames has available CRAY C90 conventional supercomputers, state of the art workstations, and high speed networks.

Contact:
Goddard Space Flight Center
Jim Fischer
(301) 286-3465
fischer@jacks.gsfc.nasa.gov

HPCC/Earth and Space Sciences (ESS) Project — This project focuses on development of scalable algorithms and applications on massively parallel computing systems to make progress toward the solution of Grand Challenge investigations in a broad range of Earth and space science disciplines. In support of the Grand Challenge investigations, ESS is interested in developing advanced software technology including parallel computational techniques, approaches for architecture independent parallel programing, and software tools for accessing and managing massive science data sets.

Contact:
Jet Propulsion Laboratory
Robert D. Ferraro
(818) 354-1340
ferraro@zion.jpl.nasa.gov

HPCC/Earth and Space Sciences (ESS) Project — JPL is conducting research in system software, user tools, and parallel computational methods for MIMD (Multiple-Instruction Multiple-Data) architectures. Specific focus areas include: software technology to enhance portability and performance, distributed visualization, and parallel algorithms for solving partial differential equations. Researchers will have access to a variety of parallel architectures. This work is in support of the HPCC ESS Grand Challenge applications, which include multidisciplinary modeling of Earth and space phenomena, and analysis of data from remote sensing instruments.

Contact:
Langley Research Center
Manual D. Salas
(804) 864-2254
salas@clyde.larc.nasa.gov

HPCC/Computational Aerosciences Project — Research interests include, but are not limited to, the following areas: research on numerical methods for the solution of tightly coupled multidisciplinary problems that can be efficiently implemented on massively parallel computers; research on novel optimization methods that are robust and can efficiently solve problems with a large number of design variables and constraints as they occur in the design of aircraft shapes; and research on data management, domain decomposition methods, and/or data visualization for multidisciplinary problems using massively parallel computers.

Contact:
Lewis Research Center
Russell Claus
(216) 433-5869
claus@lercuts.lerc.nasa.gov

HPCC/Computational Aerosciences Project (Numerical Propulsion Simulation) — Development of a propulsion system simulator involving the integration of disciplines, components, and high performance computers into a high level software environment. Of particular interest is the structuring of object oriented component models within a data flow control network. The numerically intensive component models will employ various parallel processing strategies to speed the overall system processing times. Various algorithms will be explored to solve complex geometry, time varying, engine system problems on a heterogeneous network of computers.

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Proposals Due February 1

NASA Graduate Student Researchers Program Proposal in High Performance Computing and Communication (HPCC)

Proposal Cover Sheet

I. Student Information

Name: (Mr./Ms.)

_____

Last First MI

Birth Date:_____

Birthplace:_____

Home Address:_____

_____

Home Phone:_____

Target Degree: ___MS ___MS/PhD (joint) ___PhD

Discipline:_____

Department:_____

Campus Address:_____

Mail Code:_____

University:_____

Street Address:_____

City, State, ZIP:_____

Campus Phone:_____Fax No.:_____

E-Mail:_____

Undergraduate GPA:_____Out Of:_____

Discipline:_____

Graduate GPA (If Applicable):_____Out Of:_____

Discipline:_____

I certify that I am a citizen of the United States and that I am or will be a full-time graduate student at the university during the period covered by this proposal.

*Signature:*_____*Date:*_____

II. Faculty Advisor Information

Name:_____

Department:_____

Campus Address:_____

Mail Code:_____

University:_____

Street Address:_____

City, State, ZIP:_____

Campus Phone:_____

Fax Number:_____

E-Mail:_____

*Signature:*_____*Date:*_____

III. Official Responsible for Committing Institution

Name:_____

Title:_____

University:_____

Street Address:_____

City, State, ZIP:_____

Campus Phone:_____

*Signature:*_____*Date:*_____

IV. Proposal Information

Type of Proposal: ☐ (1) New ☐ (2) Second Year ☐ (3) Third Year

If Renewal, Designate Grant No.: NGT-_____ Proposed Start or Renewal Date:_____

Expected Graduation Date: _____ Budget Amount_____

Proposal Title _____

_____

Time Spent at NASA Center during past year: _____ weeks _____ months

V. Submission Information

☐ NASA Centers

___ Ames/Dryden (ARC/DFRF)

___ Goddard (GSFC)

___ Jet Propulsion Lab (JPL)

___ Langley (LaRC)

___ Lewis (LeRC)

Center Technical Advisor:

_____

Other Facilities to which this proposal is being submitted:

_____

VI. Proposal Checklist

☐ Original Proposal and 9 Copies

☐ Budget Form

☐ University Certifications
- Suspension and Debarment
- Drug Free Workplace

☐ Signed Advisor Evaluation or Letter of Recommendation

☐ Transcripts

VII. NASA Use Only

☐ Org/Cpys

☐ BdgtFrm

☐ UCert

☐ SAE

☐ T

Privacy Act Statement

General

Pursuant to Public Law 93-579, Privacy Act of 1974, as amended (5U.S.C.§552a), the following information is being provided to persons who are asked to provide information to obtain a NASA Graduate Student fellowship.

Authority

This information is collected under the authority of the National Aeronautics and Space Act. Publication 85-568, as amended, 42 U.S.C.§2451, et. seq.

Purpose and Uses

The information requested on the application form will be used to determine your eligibility for participation in the NASA Graduate Student Researchers Program. The information requested regarding your ethnic/racial/disability status will be used to determine the degree to which members of each ethnic/racial/disability group are being reached by NASA's announcement of this program, and will not affect your application. Additionally, NASA may disclose this information to other organizations or individuals having relationships with NASA, including but not limited to academic organizations, nonprofit organizations, and other governmental agencies, as well as Congressional offices in response to an inquiry made on your behalf. Disclosure may also be made to concerned parties in the course of litigation, to law enforcement agencies, and to other Federal agencies in exchanging information pertinent to an agency decision.

Effects of Nondisclosure

Furnishing the information on the application form is voluntary, but failure to do so may result in NASA's inability to determine eligibility for participation and selection for award in the Graduate Student Researchers Program. However, your application will not be affected if you choose not to provide information on your ethnic, racial, or disability status.

Optional Information Form

In order to determine the degree to which members of each ethnic/racial/disability group are reached by this announcement, NASA requests that the student check the appropriate block(s). Submission of this information is optional and will not affect your application.

☐ **AMERICAN NATIVE OR ALASKAN NATIVE**
☐ **ASIAN**
☐ **BLACK**
☐ **HISPANIC**
☐ **PACIFIC ISLANDER**
☐ **WHITE**

☐ **INDIVIDUAL WITH DISABILITIES***

☐ **MALE**

☐ **FEMALE**

AMERICAN NATIVE OR ALASKAN NATIVE: A person having origins in any of the original peoples of North America and who maintains cultural identification through tribal affiliation or community recognition.
ASIAN: A person having origins in any of the original peoples of East Asia, Southeast Asia or the Indian subcontinent. This area includes, for example, China, India, Indonesia, Japan, Korea and Vietnam.
BLACK, NOT OF HISPANIC ORIGIN: A person having origins in any of the black racial groups of Africa.
HISPANIC: A person of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish culture or origin, regardless of race.
PACIFIC ISLANDER: A person having origins in any of the original peoples of Hawaii; the U.S. Pacific territories of Guam, American Samoa, and the Northern Marinas; the U.S. Trust Territory of Palua; the islands of Micronesia and Melanesia; or the Phillipines.
WHITE, NOT OF HISPANIC ORIGIN: A person having origins in any of the original peoples of Europe, North Africa, or the Middle East.

*An individual having a physical or mental impairment that substantially limits one or more major life activities; who has a record of such impairment; or who is regarded as having such impairment.

NASA Graduate Student Researchers Program in High Performance Computing and Communication Budget Information

I. Student Stipend (Maximum of $16,000) $_____

II. Student Allowance (Itemize if necessary)

Student Allowance $_____
(Maximum of $3,000)

III. University Allowance (Itemize if necessary)

University Allowance $_____
(Maximum of $3,000)

Total Requested $_____
(Maximum of $22,000)

Section V

1995 NASA Graduate Student Fellowships in Global Change Research

NASA Graduate Student Fellowship in Global Change Research

NASA announces graduate student training fellowships for persons pursuing a Ph.D. degree in aspects of global change research. These fellowships will be available for the 1995 academic year. The purpose is to ensure a continued supply of high-quality scientists to support rapid growth in the study of Earth as a system. Over 250 fellowships have been awarded since the inception of the program in 1990. Up to 50 new fellowships will be awarded each year, subject to availability of funds.

Contact:
Dr. Ghassem Asrar
Office of Mission to Planet Earth
Code YS
National Aeronautics and Space Administration
Washington, DC 20546-0001
(202) 358-0273

Mail Global Change Fellowship proposals to:
Global Change Fellowship
Code YSP-44
NASA Headquarters
300 E Street, SW
Washington, DC 20546-0001

Proposals sent by express mail, commercial delivery, or courier, send to:
Global Change Fellowship
Code YSP-44
Attn: Receiving and Inspections
NASA Headquarters
300 E Street, SW
Washington, DC 20024-3210

Areas of Support — Applications will be considered for research on climate and hydrologic systems, ecological systems and dynamics, biogeochemical dynamics, solid Earth processes, human interactions, solar influences, and data and information systems. Atmospheric chemistry and physics, ocean biology and physics, ecosystem dynamics, hydrology, cryospheric processes, geology, and geophysics are all acceptable areas of research, provided that the specific research topic is relevant to NASA's global change research efforts including the Earth Observing System, the Tropical Rainfall Measuring Mission, and Mission to Planet Earth. Literature describing these programs will be made available upon request for those who have not received a copy in past years. To receive a copy, please write to Ms. Anne Novotny, Code YM, NASA Headquarters, 300 E Street SW, Washington, DC 20546 or call (202) 358-0855.

Terms and Conditions — Awards are made initially for one year and may be renewed annually, usually no more than two times, based on satisfactory progress as reflected in academic performance and evaluations by the faculty advisor. The amount of award is $20,000/per annum, which may be used to defray living and educational expenses, tuition, and fees. A further amount of $2,000 is available by request for the faculty advisor's use in support of the student's research.

Eligibility — Students admitted to or already enrolled in a full-time Ph.D. program at accredited U.S. universities are eligible to apply. Students may enter the program at any time during their graduate work. Students may also apply in their senior year prior to receiving their baccalaureate degree, but must be admitted and enrolled in a Ph.D. program at a U.S. university at the time of the award. An individual accepting this award may not concurrently receive other Federal funds, including funds from other Federal fellowships, traineeships, or employment. United States citizens and resident aliens will be given preference, although the program is not restricted to them.

Equal Opportunity — No applicant shall be denied consideration or appointment as a NASA Global Change Fellow on grounds of race, creed, color, national origin, age, or sex.

Obligation to the Government — A student receiving support under the Global Change Fellowship program does not thereby incur any formal obligation to the Government of the United States. However, the objectives of this program will clearly be served best if the student is encouraged to actively pursue research or teaching in global change research after completion of graduate studies.

Disposition of Unused Funds — In case a student or faculty advisor ceases to participate in the program for any reason, the university with prior NASA approval may appoint another student or faculty advisor to complete the remaining portion of the grant period provided the area of research remains the same. Renewal applicants who have funds remaining from their previous year's budget may carry the balance over into the following program year.

Selection of Proposals —
Proposals will be judged by NASA Headquarters on a competitive basis. Criteria for selection include: (a) academic excellence as based on transcripts and a letter of reference by the student's academic advisor; (b) the quality of the proposed research for students already in graduate school; and (c) the relevance of the proposed research to NASA's role in the U.S. Global Change Research Program (Mission to Planet Earth). Selection panels will include representation from the academic community, NASA's Office of Mission to Planet Earth and Education Division, and professional societies in the Earth sciences.

Application Procedures —
Applicants are required to make available: (a) a completed application form; (b) a titled five-page research proposal for those already enrolled in a program of study or a statement of research interest for those entering graduate school; (c) a short abstract (one-half page) summary describing the proposed research (if you are already enrolled in graduate school) or proposed research interests (if you are not yet enrolled); (d) copies of undergraduate and graduate transcripts; (e) a letter of reference from the academic advisor; and (f) a schedule stating the proposed start date and completion date of your plan of study and/or research program. One original and seven (7) copies of the application form, proposal, transcript, and letter of reference should be forwarded as a package. It is the student's responsibility to ensure that these documents are received at NASA Headquarters by the March 15, 1995 deadline. Applications not submitted and complete by March 15 will not be considered in the selection process. All application packages must also include (1) debarment and suspension certifications; and (2) drug-free workplace certifications from the university.

Results of the competition will be announced July 14 of each year, with the anticipated starting date of awarded fellowships to be September 1 of each year. Results will be mailed to the students' university address, unless requested in writing to be forwarded to an alternate address.

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Proposals Due February 1

NASA Graduate Student Fellowships in Global Change Research ■ Application Form

I. Student Information

Name: (Mr./Ms.)

_____
Last First MI

Birth Date:_____

Birthplace:_____

Permanent Address:_____

_____

Home Phone:_____

Citizenship:_____

Expected Degree Completion Date:_____

Target Degree: ___MS ___MS/PhD (joint) ___PhD

Discipline:_____

Department:_____

Campus Address:_____

Mail Code:_____

University:_____

Street Address:_____

City, State, ZIP:_____

Campus Phone:_____Fax No.:_____

E-Mail:_____

Undergraduate GPA:_____Out Of:_____

Discipline:_____

Graduate GPA (If Applicable):_____Out Of:_____

II. Faculty Advisor Information

Name:_____

Department:_____

Campus Address:_____

Mail Code:_____

University:_____

Street Address:_____

City, State, ZIP:_____

Campus Phone:_____

Fax Number:_____

E-Mail:_____

III. Official Responsible for Committing Institution

Name:_____

Title:_____

University:_____

Street Address:_____

City, State, ZIP:_____

Campus Phone:_____

☐ Drug-Free Workplace Certification

☐ Debartment and Suspension Certification

*Signature:*_____*Date:*_____

IV. Proposal Information

Applicable Global Change Category (check only **one** category)

____ Climate and Hydrologic Systems ____ Solar influences ____ Solid Earth Processes

____ Ecological Systems and Dynamics ____ Biogeochemical Dynamics ____ Data and information Systems

____ Human Interactions

Proposal Title (not to exceed 260 characters):

V. Submission Information

☐ Application Form ☐ Research Proposal (5-6 pages) ☐ Abstract ☐ Application Form

☐ Recommendation Letter ☐ Schedule ☐ Budget ☐ Optional Information Form
(not required for consideration)

I certify that I am or will be a full-time graduate student enrolled at an accredited U.S. university during the period covered in the attached proposal.

Signature _____ Date _____

Privacy Act Statement

General

Pursuant to Public Law 93-579, Privacy Act of 1974, as amended (5U.S.C.§552a), the following information is being provided to persons who are asked to provide information to obtain a NASA Graduate Student fellowship.

Authority

This information is collected under the authority of the National Aeronautics and Space Act. Publication 85-568, as amended, 42 U.S.C.§2451, et. seq.

Purpose and Uses

The information requested on the application form will be used to determine your eligibility for participation in the NASA Graduate Student Researchers Program. The information requested regarding your ethnic/racial/disability status will be used to determine the degree to which members of each ethnic/racial/disability group are being reached by NASA's announcement of this program, and will not affect your application. Additionally, NASA may disclose this information to other organizations or individuals having relationships with NASA, including but not limited to academic organizations, nonprofit organizations, and other governmental agencies, as well as Congressional offices in response to an inquiry made on your behalf. Disclosure may also be made to concerned parties in the course of litigation, to law enforcement agencies, and to other Federal agencies in exchanging information pertinent to an agency decision.

Effects of Nondisclosure

Furnishing the information on the application form is voluntary, but failure to do so may result in NASA's inability to determine eligibility for participation and selection for award in the Graduate Student Researchers Program. However, your application will not be affected if you choose not to provide information on your ethnic, racial, or disability status.

Optional Information Form

In order to determine the degree to which members of each ethnic/racial/disability group are reached by this announcement, NASA requests that the student check the appropriate block(s). Submission of this information is optional and will not affect your application.

☐ **AMERICAN NATIVE OR ALASKAN NATIVE**

☐ **ASIAN**

☐ **BLACK**

☐ **HISPANIC**

☐ **PACIFIC ISLANDER**

☐ **WHITE**

☐ **INDIVIDUAL WITH DISABILITIES***

☐ **MALE**

☐ **FEMALE**

AMERICAN NATIVE OR ALASKAN NATIVE: A person having origins in any of the original peoples of North America and who maintains cultural identification through tribal affiliation or community recognition.
ASIAN: A person having origins in any of the original peoples of East Asia, Southeast Asia or the Indian subcontinent. This area includes, for example, China, India, Indonesia, Japan, Korea and Vietnam.
BLACK, NOT OF HISPANIC ORIGIN: A person having origins in any of the black racial groups of Africa.
HISPANIC: A person of Mexican, Puerto Rican, Cuban, Central or South American or other Spanish culture or origin, regardless of race.
PACIFIC ISLANDER: A person having origins in any of the original peoples of Hawaii; the U.S. Pacific territories of Guam, American Samoa, and the Northern Marinas; the U.S. Trust Territory of Palua; the islands of Micronesia and Melanesia; or the Phillipines.
WHITE, NOT OF HISPANIC ORIGIN: A person having origins in any of the original peoples of Europe, North Africa, or the Middle East.

*An individual having a physical or mental impairment that substantially limits one or more major life activities; who has a record of such impairment; or who is regarded as having such impairment.

NASA Graduate Student Fellowships in Global Change Research
Budget Information

I. Student Stipend, Tuition, Fees, Travel (Maximum of $20,000) $_____

II. Faculty Advisor (Maximum of $2,000) $_____

Total Requested $_____
(Maximum of $22,000)